ASIAN DEVELOPMENT BANK
Independent Evaluation Department

IMPACT OF RURAL WATER SUPPLY AND SANITATION

IN

PUNJAB, PAKISTAN

In this electronic file, the report is followed by Management's response, and the Board of Directors' Development Effectiveness Committee (DEC) Chair's summary of a discussion of the report by DEC.

ADB

Evaluation Study

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Impact of Rural Water Supply and Sanitation in Punjab, Pakistan

Independent Evaluation Department

Asian Development Bank

CURRENCY EQUIVALENTS
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$1.00	=	PRs 81.4

ABBREVIATIONS

ADB	–	Asian Development Bank
ADTA	–	advisory technical assistance
CBO	–	community-based organization
CCB	–	citizen community board
CO	–	community organization
DID	–	difference in difference
DMC	–	developing member country
DMF	–	design and monitoring framework
DSM	–	demand-side management
EIRR	–	economic internal rate of return
ERD	–	Economics and Research Department
IED	–	Independent Evaluation Department
KAP	–	knowledge, attitude, and practice
MICS	–	multiple indicator cluster survey
NSP	–	National Sanitation Policy
O&M	–	operation and maintenance
OIST	–	Office of Information Systems and Technology
PCR	–	project completion report
PCWSSP	–	Punjab Community Water Supply and Sanitation Project
PHED	–	Public Health Engineering Department
PRWSSP	–	Punjab Rural Water Supply and Sanitation Sector Project
PSP	–	public standpost
RIE	–	rigorous impact evaluation
RSDD	–	Regional and Sustainable Development Department
SUPER	–	social uplift and poverty eradication program
TMA	–	*tehsil* municipal administration
WSS	–	water supply and sanitation

Key Words

asian development bank, development effectiveness, independent evaluation department, impact evaluation, rigorous impact evaluation, sustainability analysis, water supply and sanitation

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The guidelines formally adopted by the Independent Evaluation Department (IED) on avoiding conflict of interest in its independent evaluations were observed in the preparation of this report. Pakistan-based North West Development Associates and Contech International assisted with data collection for the study, and Aniceto Orbeta, Jr., was the consultant who assisted in the econometric analysis. Guntur Sugiyarto and Yi Jiang, economists of the Economics Research Department, provided guidance on quantitative data analysis. The external peer reviewers were Ghulam Mustafa and Richard Palmer-Jones. To the knowledge of the management of Independent Evaluation Department, there were no conflicts of interest of the persons preparing, reviewing, or approving this report.

APPENDIXES

SUPPLEMENTARY APPENDIXES (available on request)

Attachment:	Management Response DEC Chair Summary

EXECUTIVE SUMMARY

Globally, 1.1 billion people live without access to safe water supply, and 2.4 billion live without adequate sanitation. In the Asia and Pacific region, 700.0 million are without water supply, and 2.0 billion are without adequate sanitation. The problem is particularly grave and pressing in the rural areas, where 70% of the world's poor reside (Asian Development Bank's [ADB's] 2006 Discussion Paper, *Serving the Rural Poor: A Review of Civil Society-Led Initiatives in Rural Water Supply and Sanitation*). While the emphasis has been on expanding coverage, an independent expert panel reported in its 2006 review of the water policy of ADB that it did not find empirical evidence to suggest that poor people necessarily benefit from improved coverage. In its 2007 thematic evaluation of water supply and sanitation (WSS), the European Commission noted that, in the absence of valid impact data, no definitive statement can be made on the role of European Commission investment in WSS in promoting better health. However, available information pointed to a qualified success and that European Commission investment has made a positive contribution to better health in target groups. Multiple impacts and long time and resource requirements mean that rigorous impact evaluations (RIEs) of the WSS sector are seldom conducted.

Purpose

The objectives of the study were to assess project performance and identify lessons for maximizing the development effectiveness of WSS interventions, by conducting an RIE. It aimed to (i) quantify the impact of WSS assistance on household welfare with a focus on health, education, and employment and (ii) evaluate the sustainability of WSS interventions. The sustainability analysis focused on two key aspects of the WSS projects: (i) technical and physical status and (ii) the capacity of community-based organizations (CBOs) responsible for the operation and maintenance (O&M) of subprojects.

Methodology and Data

The study was conducted in Punjab Province of Pakistan and covered two sector projects, the Punjab Rural Water Supply and Sanitation (Sector) Project (PRWSSP, ADB's 1994 *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to Pakistan for the Punjab Rural Water Supply and Sanitation Project*) and the Punjab Community Water Supply and Sanitation (Sector) Project (PCWSSP, ADB's 2002 *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to Pakistan for the Punjab Community Water Supply and Sanitation Project*), both funded by ADB. Both projects were designed to address basic human needs such as provision for water using a community-driven development approach. It employed a combination of qualitative and quantitative methods to collect and analyze relevant data and report findings. The study area was in 7 randomly selected districts of the 30 covered by the PRWSSP and the PCWSSP. One hundred fifteen subprojects were identified using stratified random sampling methods. The sample subprojects accounted for 10% of total number of subprojects under the two projects, and 22% of subprojects in the seven sample districts. The Public Health Engineering Department had handed over water distribution management and O&M of all sample subprojects to CBOs at least 12 months prior to the survey. A total of 1,301 treatment households covered by a project and 1,301 comparison households outside the projects, selected using stratified random sampling method, took part in the household surveys. The number of sample households for each sample subproject was proportional to its relative share of the total, and a quasi-experimental design was adapted to analyze household data. The sample households and subprojects appropriately represented geographical distribution, agro-ecology, subproject typology (PRWSSP versus PCWSSP, new construction versus rehabilitation, and water supply versus WSS), and socioeconomic conditions of the study areas. In the absence of household baseline data, the study used the single difference method of estimation. The comparison communities were identified using 1998 district census reports. Four key community-level parameters were used for matching purposes: (i) total village area, (ii) number of households with potable water, (iii) average household size, and (iv) literacy rates. The absence of potable water was a major consideration in selecting project villages for WSS intervention. Since community level parameters associated with public health status were not available, these could not be used as a basis for selecting comparison communities. The sustainability analysis undertook (i) a technical survey of the same 115 subprojects selected for the household survey; (ii) focus group discussions with each of the 115 CBO executives responsible for the O&M of the subprojects; and (iii) a knowledge, attitude, and practice survey of 1,400 adults and children in the project and comparison communities. Given its methodological superiority, project impact results based on multivariate analysis rather than the differences in means or proportions are discussed in this report.

The study was conducted with some methodological limitations. The absence of baseline data for individuals and households limited the study to adopt a single difference "with and without project" approach, rather than augmenting this with "before and after" to produce double difference comparisons. In the absence of usable baseline data, the comparison households were actually synthetic controls based on community attributes rather than real controls. While the differences between treatment and comparison households were minimized by controlling for relevant individual, household, and community characteristics, unobserved differences could not be controlled. With baseline data, the impact of time-invariant unobservable characteristics could have been removed. Also, comparison households and individuals could not be identified due to the unavailability of comparable rosters at the time of project intervention. However, the similarities of attributes of respondents and communities in project and comparison communities confirmed that matching at the community level was successful. The sustainability analysis is based on descriptive statistics collected during technical survey and focus group discussions with the CBO management teams.

Impact Results

The study first assessed projects' influence on access to water supply and thereafter estimated welfare impacts on (i) health, (ii) education, and (iii) labor force participation rate and hours worked. The results show that the projects had clear and large influence on the intermediate outcome—that is, access to water supply. The projects drastically reshaped the sources of household water in project areas, raising the proportion of households with piped water in their dwellings and reducing reliance on hand pumps, tubewells, and boreholes, which were still the major sources of water in the comparison villages. Consequently, the time spent and distance traveled to fetch water had been reduced significantly. The impact on sanitation, however, was statistically insignificant. This is not surprising given the projects' minimal resource allocation to hygiene and sanitation relative to their allocations for civil works, equipment, and materials, which absorbed almost 90% of project resources. As such, the two projects can be considered as water supply rather than WSS projects.

The significant impact of the projects on health was consistently revealed in terms of reduced drudgery or pain associated with fetching water. However, the projects' reduction of the incidence of waterborne illness such as diarrhea, and of its severity, was insignificant, though disaggregated analysis revealed some cases, particularly in the middle socioeconomic group. The projects significantly contributed to increasing school attendance, particularly among high school children. It is noteworthy that the positive impact in this age group was statistically significant for girls but not for boys. The reduction of time spent fetching water, rather than the reduction in labor force participation, explains the significant improvement in the attendance rate for children of high school age in project communities over comparison communities. The findings do not support the hypothesis that the projects significantly increased labor force participation and work hours, with the exception of the middle socioeconomic group. Time saved from fetching water, as documented in the study, did not translate into increased income, reflected by there being no significant increase in labor force participation or hours worked. This may be because of prevailing high unemployment and underemployment in the project areas, individual preference for leisure, social restriction on girls' employment, and/or other reasons.

The findings by socioeconomic group revealed some interesting results and highlighted that impacts were not uniform across socioeconomic strata. The projects significantly reduced the incidence of diarrhea in the middle socioeconomic group. Similarly, drudgery reduction was statistically significant in the lowest socioeconomic group but not in the middle or highest socioeconomic groups. The education impact was felt strongly in the middle socioeconomic group. Although fewer children refused to go to school for lack of safe water in both project and comparison areas, school dropout rates were significantly lower in project areas than in comparison areas in the lowest socioeconomic group. The provision of toilet facilities in the school had no significant impact on school dropout rates. The labor force participation rate, however, statistically declined for school goers in the age groups 11–17 and 18–24 in the middle socioeconomic group resulting from the projects. In addition, projects significantly reduced the hours worked per week by 11–17 year olds in the middle socioeconomic group. The reduction in labor force participation and hours worked may have led to increased school attendance and/or increased leisure. The more positive impact overall on the middle socioeconomic group may suggest that this group had a stronger influence on project activities than did other groups.

Comparison of the different types of projects shows mixed results. Using matched villages, the results demonstrate larger impacts in terms of better health, fewer household members reporting drudgery from fetching water, and a lower proportion of children not attending school for lack of water facilities, from the older PRWSSP than the more recent PCWSSP. This may suggest that the subprojects under the PRWSSP were better targeted to address local needs.

Sustainability Results

The study evaluated the sustainability of project benefits based on (i) technical and physical attributes of subprojects, and (ii) capacity assessment of CBOs for overall management, and O&M. Overall, 80% of the water supply systems provided water to the beneficiaries and, hence, were functional, with the proportion greater under the PCWSSP, at 89%, than under the PRWSSP, at 68%. The functionality of water supply systems positively correlated with the lack of alternative water sources. Similarly, willingness to pay for water was found to be higher in areas with no alternative water sources. Water supply system efficiency varied widely and it could have been improved if sufficient attention had been given to basic management practices. The projects took sufficient care in identifying water sources uncontaminated by heavy metals, but bacteriological contamination was found to be high in many locations. While chlorination kits were provided, these were not used in most of the subprojects. However, households widely practiced boiling water for drinking purposes. As a result, negative impact of bacteriological contamination on diarrhea incidence was not found. A change in local perceptions about the technical deterioration of water systems is a concern and would call for necessary support and redress through technical backstopping and improved institutional arrangements. However, rising fuel costs, electricity tariff, and erratic power supply pose major challenge to sustainability.

The status of CBOs running the subprojects was less than satisfactory, as only 43% of the sample subproject CBOs were considered partly or fully functional. Positive correlation between the functional status of the CBOs and process ownership suggested the need to strengthen the capacity of the CBOs. While both projects were designed to integrate water supply, sanitation, and hygiene promotion—and both hired dedicated staff for community development and hygiene promotion—sanitary hazards were high in many locations. The information, education, and communication materials developed under the hygiene education program were less effective and less useful for local needs because (i) the booklets were heavily text driven and had limited readability, and (ii) other materials were sparingly used and did not reach intended beneficiaries. In addition, project support in linking with service providers, including microfinance institutions, was of little relevance in the project context due to prior strong presence of microfinance institutions, which raises questions about including a social-uplift and poverty-eradication program in the PCWSSP.

Financial sustainability could not be assessed due to lack of data but it appeared to be a major challenge for majority of the subprojects; more so for capital replacements and routine maintenance works. However, local enthusiasm was strong and they were willing to pay more for water in functional CBOs and water deficit areas despite of only modest capacity of these CBOs to meet immediate O&M requirement.

Overall Performance Assessment

The study rates the overall performance of ADB's assistance to rural water supply in Pakistan’s Punjab Province as successful but at the lower end of the scale. This is based on the findings of this study, assessments reported in the project completion reports of the two projects, and validation by the Independent Evaluation Department of the PCWSSP project completion report. The projects were rated relevant, effective, efficient at the low end, and sustainable at the low end. In aggregate terms, the projects had positive impact on local communities and people, and project impacts are likely to be sustained with required technical support and the strengthening of the CBOs responsible for managing respective subprojects. Some of the major concerns are: (i) 20% of the subprojects are nonfunctional; (ii) only 43% of CBOs responsible for subprojects are functional; (iii) cost recovery and capital replacement mechanisms are not built-in; (iv) high fuel and electricity costs, and erratic power supply have potential to bring operational subprojects to halt; (v) CBOs capacity remains weak; (vi) government commitment to continued support for subprojects is weakening; (vii) participation of poor remains low due to upfront cash requirements; and (viii) operational link between the Public Health Engineering Department and the *tehsil* municipal administrations remains very weak.

Lessons and Implications

The study provides a set of five key lessons for future rural WSS operations. First, rural WSS projects deliver significant gender benefits in terms of (i) reduced drudgery for women and girls engaged in fetching water, and (ii) increased girls' attendance particularly at the high school level. Second, current rural WSS project designs largely focus more on improving water access to the households, and less on ensuing wastewater and solid waste management issues. Hence, the project designs need to (i) be based on lessons from past operations of ADB and other development partners and conceptual framework demonstrating clear linkages between planned development interventions and expected outcomes and impacts; (ii) include only directly relevant components and each component must be adequately resourced and implemented by the most appropriate agency; (iii) develop synergy between water supply and sanitation with strong commitment and focus supported by sizable investment in sanitation; (iv) make provision for a functional monitoring and evaluation arrangements with baseline data for the project and comparison (control) areas; (v) recognize the medium to long-term role of NGOs and private sector in supporting CBOs; (vi) make provision for additional mechanism for WSS to poorest of the poor and other disadvantaged groups because an upfront cash requirement for household connection limits their participation in conventional WSS projects and (vii) strengthen voices of females in the design and implementation arrangements. Third, ADB need to proactively partner with other development partners in WSS specifically in the areas of (i) creating demand for sanitation investment; (ii) improving delivery of safe water; (iii) strengthening institutional capacity of CBOs, NGOs and private sector; (iii) strengthening institutional incentive structure for effective management and WSS services; and (iv) water demand analysis, water resource mapping and water use regulations. Fourth, collecting valid baseline data on individuals, households, and communities along with valid counterfactuals (comparison groups) is critical for assessing results and conducting rigorous impact evaluations which can assist in quantifying the impact of development interventions on household welfare. Fifth, to maximize sustainability of project benefits (i) assistance may be required to bridge finance O&M in the initial years of operations even after project completion; (ii) the capacity of CBOs need to be strengthened to address technical, managerial and financial management issues; (iii) there is a need for an effective post-completion monitoring mechanism to ensure smooth operation of WSS systems; and (iv) the linkages between the CBOs with PHED, TMAs and private businesses must be strengthened. Second,

Recommendations for Consideration

Based on the above, following recommendations are made for consideration by ADB management:

Recommendation	Responsibility	Timing
1. **Rural WSS projects significantly benefit women and girls, hence, gender benefits should receive more prominence in similar ADB projects with increased focus on women's role in decision-making, and facilitating access to education** (paras. 83 and 101).	Regional departments	From January 2010
2. **Current focus is largely on improving access to water supply, although management of waste water and solid wastes is critical for better health. ADB WSS projects designs should address waste management concurrently. In addition, ADB should improve project designs** (paras. 84–89, and 102) by (i) conceptualizing likely economic, social, environmental, and institutional impacts on human lives and the environment based on development lessons; (ii) including only directly relevant components; (iii) setting realistic outcome and impact targets; (iv) including baseline data on project households and communities and their comparators (control groups); (v) increasing investment in environmental sanitation, and developing improved synergies between water supply	Regional departments	From January 2010

Recommendation	Responsibility	Timing
and drainage, and solid waste and waste water management; (vi) recognizing the medium- to long-term roles of NGOs and the private sector in strengthening local CBOs and marking necessary provisions; (vii) making additional provision such as community taps for poorest of the poor households; (viii) incorporating viable financial structuring with back up provisions such as transition and operational support funds; and (ix) making provision for monitoring and evaluation of project implementation and project operation during initial years.		
3. **Inter-agency coordination is weak and, hence, ADB should actively strengthen existing collaborations and partnerships and foster new ones with other development partners and DMCs in water supply and sanitation** (paras. 90–95, and 103) to (i) maximize positive health outcomes and impacts by creating demand for sanitation investment; (ii) improve water quality and deliver safe water; (iii) strengthen institutional capacity at all levels; (iv) develop functional institutional incentive structure, (v) conduct water demand analysis; and (vi) identify demand for water, map out available water resources to avoid conflict in water use, and formulate required regulations in water use.	Regional departments and RSDD	From January 2010
4. **Baseline data is vital for results monitoring and evaluation. ADB should establish a user-friendly depository of all available baseline studies and associated databases** (paras. 96, 97, and 104) by (i) including ex-ante baseline studies in project design to reflect identifiable indicators for assessing expected developmental impact at the individual, household, and community level, as well as the sustainability requirements of intended interventions; (ii) allocating resources for including such studies in the project; and (iii) establishing a user-friendly depository of baseline survey data for ADB-wide use.	ERD, OIST, regional departments, and RSDD	From January 2010
5. **Sustainability of project benefits must be ensured. ADB, should follow-up with the Government of Punjab to address the following** (paras. 98–100, and 105): (i) functional link between PHED and TMAs and the private sector is strengthened; (ii) subprojects become financially viable with provisions for routine maintenance, O&M, and capital	CWRD, PRM	October 2009 to December 2012

Recommendation	Responsibility	Timing
replacement; (iii) nonfunctional subprojects are revived if technically and economically feasible; and (iv) nonfunctional or partly functional CBOs become fully functional through capacity building by engaged competent NGOs and private sector entities.		

ADB = Asian Development Bank, CBO = community-based organization, CWRD = Central and West Asia Department, DMC = developing member country, ERD = Economics and Research Department, NGO = nongovernment organization, OIST = Office of Information Systems and Technology, O&M = operation and maintenance, PHED = Public Health Engineering Department, PRM = Pakistan Resident Mission, RSDD = Regional and Sustainable Development Department, TMA = tehsil municipal administration, WSS = water supply and sanitation.
Source: Study Findings and Lessons.

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I. INTRODUCTION

A. Background and Rationale

1. The international community increasingly requires development institutions such as the Asian Development Bank (ADB) to demonstrate development effectiveness by undertaking more rigorous impact evaluation (RIE) and managing for development results. The role of evaluation in this context is to assess results in a credible and independent fashion, contribute to learning and accountability, and provide the basis for effective policy decisions and program improvement (Network of Networks on Impact Evaluation draft statement on impact evaluation, February 2008).[1] The community wants to ensure that development resources from tax payers are invested in programs and projects that work, which requires more effort in demonstrating impact on the ground. The Center for Global Development report highlights an evaluation gap that exists because measurement of impact is rare.[2] The report states that, in the absence of verifiable impact measures, program designers benefit little from accrued experience about what works and that developing country governments and their donor partners have little basis upon which to defend the wisdom of their investment or make adjustments. As a result, policy makers faced dilemmas in allocating resources.

2. The recent emphasis on accountability and results-based management has stimulated interest in evaluating not just the process, outputs, and outcomes of development programs but also their impact, or ultimate effect, on people's lives. Impact evaluations go beyond documenting change to assess the effects of interventions on individual households, institutions, and the environment relative to what would have happened without them, thereby establishing the counterfactual.[3] The World Bank views it as a policy tool that helps discern the causal impact of a project or a policy initiative. Impact evaluation techniques compare the impact on beneficiaries of a certain policy intervention or project with a comparison group that has not been exposed to the same intervention or project. The results from impact evaluations can help inform policy makers on where to allocate scarce resources and provide evidence of whether current policies are working or not.[4] This rigorous approach to evaluation is increasingly advocated as a more reliable way to develop an evidence bank of what works in development and what does not work. However, RIE studies demand time and resources. Recognizing the importance of such studies, the Independent Evaluation Department (IED)[5] is selectively undertaking RIEs, completing the first in 2007.[6] This is the second.

3. Globally, 1.1 billion people live without access to safe water supply, and 2.4 billion live without adequate sanitation. In the Asia and Pacific region, 700.0 million are without water supply, and 2.0 billion are without adequate sanitation. The problem is particularly grave and pressing in the rural areas where 70% of the world's poor reside.[7] While the emphasis has been on expanding coverage, an independent expert panel reported in its 2006 review of ADB's Water Policy[8] that did not find empirical evidence to suggest that poor people necessarily

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1 Network of Networks on Impact Evaluation. 2008. *Draft Statement on Impact Evaluation*. Washington, D.C.
2 Center for Global Development. 2006. *When Will We Learn: Improving Lives Trough Impact Evaluation. Report of the Evaluation Gap Working Group.* Washington, DC.
3 Available: http://www.gsdrc.org/go/topic-guides/monitoring-and-evaluation/impact-evaluation
4 Available: http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTISPMA/0,menuPK:384339~pagePK:162100~piPK:159310~theSitePK:384329,00.html#whatis
5 IED was named the Operations Evaluation Department until December 2008.
6 ADB. 2007. *Impact of Microfinance on Rural Households in the Philippines.* Manila.
7 ADB. 2006. *Serving the Rural Poor: A Review of Civil Society-Led Initiatives in Rural Water Supply and Sanitation*. Discussion Paper. Manila.
8 ADB. 2006. *Comprehensive Review of ADB's Water Policy Implementation*. Manila.

benefit from improved coverage. In its 2007 thematic evaluation of the water supply and sanitation (WSS) sector, the European Commission noted that, in the absence of valid impact data, no definitive statement can be made on the role of European Commission investment in WSS on promoting better health. However, available information pointed to qualified success and that European Commission investment has made a positive contribution to better health in the target groups. RIE is rare in the water and sanitation sector, partly because of multiple impacts.[9]

4. While the importance of government support for WSS is growing across developing member countries (DMCs), a disproportionate share of ADB's WSS resources is allocated to urban areas (86%) largely because of high urban demand for WSS.[10] Rural areas have been comparatively disadvantaged in attracting resources. Similarly, very little is known about the sustainability of community-managed rural WSS subprojects, including financing modalities.

5. The findings of the study are expected to provide a more definitive basis upon which public policy makers can substantiate or justify increased allocations of resources for rural WSS. In the absence of representative household baseline data at present, the study further provides a basis for constructing panel data for future evaluation so that a more robust impact evaluation can be conducted in the future using the double difference method, which uses both "before and after" and "with and without" comparisons. In addition, the study separately documents good practices in community-led rural WSS subprojects in Punjab Province so that the learning can be shared with other stakeholders and used as a model in new project designs. ADB's long-term strategic framework 2008–2020 (Strategy 2020)[11] clearly states that ADB will support investment in education and essential public services, such as water and sanitation, that particularly benefit the poor and women, making paramount the development of effective ways to design rural WSS projects.

B. Objectives and Scope of the Study

6. The purpose of the study was to assess project performance and identify lessons for maximizing the development effectiveness of WSS interventions, which address basic human needs, such as WSS, by conducting an RIE. It aimed to (i) quantify the impact of WSS assistance on household welfare with a focus on health, education, and labor force participation and hours worked and (ii) evaluate the sustainability of WSS interventions. The sustainability analysis focused on two key aspects of the WSS projects: (i) technical and physical status and (ii) the capacity of community-based organizations (CBOs) responsible for the operation and maintenance (O&M) of subprojects. It was conducted in Punjab Province and covered two sector projects: (i) the Punjab Rural Water Supply and Sanitation (Sector) Project (PRWSSP) and (ii) the Punjab Community Water Supply and Sanitation (Sector) Project (PCWSSP).[12] Both

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[9] Pattanayak, S.K., C. Poulos, K.M. Wendland, S.R. Patil, J. Yang, R.K. Kwok, and C.G. Gorey. 2007. Informing the Water and Sanitation Sector Policy: Case Study of an Impact Evaluation Study of Water, Sanitation, and Hygiene Interventions in Maharastra, India. *Research Triangle Institute Working Paper 06_04*. North Carolina. The paper cites the work of Bosch, et al., which classifies impact into four areas: (i) health improvements, (ii) education, (iii) gender and social inclusion, and (iv) income/consumption increases.

[10] Based on the ADB project database. Also see Appendix 1.

[11] ADB. 2008. *Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank 2008–2020.* Manila.

[12] For project description refer to (i) ADB. 1994. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Islamic Republic of Pakistan for the Punjab Rural Water Supply and Sanitation (Sector) Project*. Manila; and (ii) ADB. 2002. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Islamic Republic of Pakistan for the Punjab Community Water Supply and Sanitation (Sector) Project*. Manila.

sector projects used a community-driven development approach and were funded by ADB. The methodology and data for impact evaluation and sustainability is outlined in paras. 31–35, and the limitations of the study are stated in para. 36.

C. Organization of the Report

7. The report has seven sections. Section II provides an overview of ADB strategy and operations in WSS and discusses coverage and scale of operations, as well as key lessons based on previous IED studies. Section III describes the two projects covered by the study, and section IV outlines the methodology adopted for the study and elaborates on conceptual framework, data, and analytical methods used. Section V presents results and discussion. Section VI summarizes the performance assessment of the two projects in terms of relevance, effectiveness, efficiency, impact, and sustainability. The final section summarizes key lessons and provides recommendations for the future ADB operations in rural WSS sector.

II. OVERVIEW OF ADB STRATEGY AND OPERATIONS IN WATER SUPPLY AND SANITATION

A. ADB's Water Strategy and Operations

8. ADB's involvement in WSS is shaped by the International Conference on Water and Environment in 1992, the World Bank and United Nations Development Programme International Conference on Water Utilities in 1992, evaluating 20 years of World Bank-funded water supply projects, the findings of the Water Utilities Data Book for the Asian and Pacific Region, and the post evaluation of ADB water supply projects.[13] The rural WSS subsector requires a strong emphasis on a community-based approach. "Basic human rights and environmental renewal" is one of the four elements of ADB's water strategy.[14] The strategy states that the three main problems facing the water sector are (i) financial sustainability, (ii) water resource availability, and (iii) equitable access, and it advocates long-term planning. The strategy notes that water rights for domestic and industrial water supplies should be secured for at least 50 years, and tariffs need to be set to reflect the financial costs and, preferably, the economic costs of water. Distortions in tariffs by which one part of a community subsidizes another need to be smoothed out, and all subprojects should make adequate supplies available in poor areas. The poor are able and willing to pay for water. In rural areas, special efforts are needed to reduce the distance to water supplies wherever possible and to encourage conservation approaches such as rainwater harvesting. It considers complementary education in hygiene essential to derive the full health benefits of improvements in infrastructure.

9. In 2006, an independent expert panel conducted a comprehensive review of ADB's 2001 Water Policy implementation and noted that the policy promotes efficiency to ensure quality, access, and affordability, as well as sustainability, in water service delivery for domestic, industrial, and agricultural use.[15] The review noted moderate progress in increasing coverage of domestic water service delivery in both rural and urban areas in DMCs. However, it did not find empirical evidence to suggest that poor people necessarily benefit from improvement in

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[13] ADB. 1992. Water Utilities Data Book for the Asian and Pacific Region. Manila; and ADB. 1994. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Islamic Republic of Pakistan for the Punjab Rural Water Supply and Sanitation (Sector) Project*: Manila (para. 23).

[14] Available: http://www.adb.org/documents/reports/water/basic_human.asp

[15] ADB. 2006. *Water for All: Translating Policy into Action.* Manila (the review panel's final report and recommendation: paras. 34–44, pages 16–18).

coverage. The review further stated: "ADB's Water Policy does not provide a clearly formulated and strong focus on O&M, or energetically promote the evaluation and use of alternative technologies where appropriate. These key factors are critical to ensure affordable and equitable services, and, inherently, linked to efficiency and cost-effectiveness in water service delivery." The panel provided five recommendations to ADB:[16] (i) increase ADB's commitment and develop its capacity; (ii) develop long-term partnerships with DMC stakeholders and donors; (iii) focus the implementation of integrated river basin management on stakeholder needs and ownership; (iv) promote "business unusual;"[17] and (v) improve processes to ensure effective policy implementation. ADB supports the general thrust of the panel's report. In particular, ADB's vision in the water sector is in line with the three key messages of the panel: (i) water is, as a resource and a service, a key driver of change and development in the Asia and Pacific region; (ii) ADB should, in its water investments, continuously balance its dual roles as a development institution and a bank; and (iii) ADB and its DMCs should significantly increase their investments in water as a service and a resource.

10. ADB began its first assistance to the WSS[18] subsector in 1968. Between 1968 and 2007, ADB approved (i) 120 WSS loans (99 urban and 21 rural) for 112 projects totaling $4.0 billion, (ii) six grants worth $20.7 million, and (iii) 184 technical assistance (TA) projects.[19] Altogether, 26 countries availed themselves of ADB assistance. The Philippines, People's Republic of China, Indonesia, Thailand, and Republic of Korea were the top five recipients. Sixty-six loans worth $2.41 billion, or 59% of the total, were funded from ordinary capital resources, and 54 loans worth $1.59 billion, or 41%, were from the concessional Asian Development Fund. The loan amount included four private sector loans worth $107.50 million. Appendix 1 shows further details.

11. Support for urban WSS has dominated the ADB water and sanitation portfolio with an 86% share, largely reflecting high demand. Assistance for rural WSS commenced in 1977.[20] In addition, several urban and rural infrastructure projects provided assistance for WSS. Between 1990 and 2007, ADB supported 14 rural WSS projects in nine countries with 17 loans totaling $600 million. In addition, 11 countries have received $9.9 million in TA for 22 projects. These projects have supported (i) the construction or rehabilitation of WSS facilities, (ii) raising awareness of health and hygiene, (iii) institutional capacity building, and/or (iv) access to microcredit for income generation. Appendix 1 provides a list of ADB projects and TA approved in the rural WSS subsector. Low uptake in rural WSS financing has been identified by ADB, and the Water Committee of the Regional and Sustainable Development Department has reported

[16] Available: http://www.adb.org/Water/Policy/panel-report.asp#a3

[17] Promoting "business unusual" means (i) leveraging innovations to increase access, affordability, efficiency, and cost-effectiveness, including nuanced guidance on subsidy use; (ii) promoting public-private partnerships; (iii) alternative financing modalities under innovative and efficient initiatives; (iv) robust O&M arrangements; and (v) scaling up alternative technologies.

[18] The WSS subsector falls under the sector of water supply and sanitation and waste management, which accounted for $6.8 billion, or 5.30%, of ADB loans in 2007. Besides WSS, the sector includes the integrated subsector (1.04% or $1.35 billion) and waste management subsector (1.06% or $1.06 billion), together representing 2.10% of ADB loans. In this study, discussions are limited to the WSS subsector.

[19] The sources of TA funds have included ADB's internal resources (41.4%), the Japan Special Fund (45.6%), and others (13.0%), including bilateral agencies and United Nations Development Programme. Of the 184 TA projects, 109 (59%) were classified as project preparatory and totaled $43.3 million, and 75 were advisory and totaled $33.4 million. Nepal, Indonesia, and Philippines are the top TA recipients, accounting for 33% of total WSS TA. The most TA projects were approved in 1993, numbering 12, and 2006, numbering 11. In addition, ADB funded 15 regional TA projects worth $12.2 million.

[20] Cost recovery and financial sustainability is considered more achievable for urban water schemes than for rural ones. DMCs are increasingly paying attention to integrated water resource management and pollution control in the rivers that supply drinking water for urban centers.

for years that ADB does not invest nearly enough in WSS in the rural areas where most of the poor live.

12. IED evaluation studies have highlighted a number of lessons from ADB WSS operations in several DMCs. Prominent among them and useful for future WSS project design and implementation are the desirability of stakeholders' active participation in all stages of the project cycle, the demand-driven selection of feasible and cost-effective subprojects, integrating water supply and sanitation in WSS subprojects, establishing effective mechanisms for collecting water-use fees, community O&M of WSS subprojects, sensitivity to ethnic and cultural norms, water quality monitoring and treatment, and careful choice of source and point of consumption. Other important considerations in future WSS projects are cost recovery, sustainable financing mechanisms for O&M, enhancing willingness to pay for safe drinking water and sanitation, building effective local community organizations and support, and capable public institutions. Selected lessons from IED studies are summarized in Appendix 2.

B. Binding Constraints on Rural Water Supply and Sanitation in Pakistan

13. WSS service delivery in Pakistan has seen dramatic changes over the past 3 decades. Starting in the 1970s, engineering departments such as works and services and irrigation departments and the Public Health Engineering Department (PHED) were created to specialize in deep drilling and implementing complicated schemes to provide services to large populations quickly through improved access to piped water. The increase in the number of costly schemes resulted in huge O&M costs. Since the 1980s, the purely engineering approach to WSS service delivery was exchanged for a more social engineering approach, but it was not fully owned by the engineering-minded management of implementation organizations and enjoyed limited success. Appendix 3 summarizes the Government of Pakistan's policy on water and sanitation. For a description of WSS in Punjab Province, see Appendix 4. The sector currently faces the following key challenges.

1. Multiplicity of Sector Players

14. Prior to the restructuring of public service delivery mechanisms in Pakistan through the promulgation of Local Government Ordinance of 2001, WSS was primarily a PHED area of responsibility. However, along with PHED, there were a number of other players in the sector, including the Local Government and Rural Development Department and now defunct municipal committees, water and sanitation agencies, development authorities, and cantonment boards, etc. Adding to the confusion created by this multiplicity of service providers, these organizations were managed mostly from provincial headquarters, often causing undue delays and bureaucratic entanglements. The Local Government Ordinance of 2001 called for creating *tehsil* (subdistrict) municipal administrations (TMAs) to provide one window for all matters concerning WSS service delivery at the subdistrict level. At present, TMAs and PHED still carry out WSS services in a manner similarly to pre-devolution in 2001. The fragmented approach in the sector and different service levels, technologies, and mandates have created overlaps and gaps. PHED has long experience in technical and contract-management matters. TMAs, representing the voice and choice of the people, provide a *de jure* grass roots service delivery channel. There are rural support programs and other local nongovernment organizations (NGOs) and/or CBOs that have experience in mobilizing communities and planning and installing mechanized water supply schemes in freshwater zones. These strengths are unfortunately scattered, and little effort has been made to concentrate them for more effective sector programs.

15. At present, there is no federal or provincial department that takes care of sanitation in rural areas. There is a need to entrust this responsibility to the appropriate provincial

department, whose role may be policy making and/or regulatory. What comes immediately to mind is the Local Government and Rural Development Department, but the role of health, environment, and PHED may also be significant in the sector.

2. Political Interests and Vertical Federal Programs

16. Politicians propose considerable numbers of water supply and drainage schemes to win votes, most often for population centers in their constituencies. The technical feasibility of such schemes is occasionally doubtful, and engineers and planners too often have limited options or incentives to scientifically judge feasibility. The member of National Assembly,[21] member of Provincial Assembly,[22] and/or senator program[23] provides schemes which are most often identified and implemented without much community discussion or participation. This directly contravenes past and current sectoral policies. The problem manifests itself primarily when the management of water delivery and O&M are handed over to communities. As the schemes were provided without any community contributions, they usually cease to functional within a short period of time.

3. Impact of Transition

17. After the promulgation of the Decentralization Act in Punjab in 2001, district and *tehsil* government officials have faced a number of issues related to their careers, seniority, and accountability to elected councils. Increased interaction between elected representatives and government officials has created opportunities but have also made government officials more vulnerable to undue pressure. There seems to be low morale in senior management, to the detriment of the objectives of devolution. As such, motivational issues remain unaddressed.[24] Weak accountability locally and lack of motivation have undermined the quality of service provision.

4. Inadequate Human Resources

18. WSS related departments in general, and TMAs in particular, lack professionally qualified planners with a background in community development and public health engineering. The deficiency of such professionals results in schemes that are unsustainable. Expertise in designing mechanized schemes appears to exist only for water, with little or no expertise in sanitation. Behavioral change requires effective communication skills to promote hygiene and sanitation, but these are in short supply or almost nonexistent in the relevant public agencies. The engineering skills that exist in PHED are mostly based in regional offices, with limited support to the local offices such as TMAs.

5. Inadequate Social Mobilization Skills and Lack of Emphasis on Behavioral Change

19. Most TMAs and district PHED offices in Punjab lack social mobilization staff. The traditional top-down approach is still practiced when planning whatever little developmental or rehabilitation work they carry out. Even in some PHED offices where some community development staff are available, their work is not taken very seriously by the engineers who

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[21] With a national legislator.
[22] With a provincial legislator.
[23] A federal program under which over PRs5 million is provided to each legislator for development programs in his or her constituency.
[24] Cyan, Musharraf, Jackie Charlton, Zahid Hasnain, et al. 2004. *Devolution in Pakistan,* Vols. 1–3. Manila: ADB (draft).

often are managers as well. The signing of community memorandums of understanding on scheme site identification, O&M arrangements, etc., is still considered by many decision makers in PHED as an unwanted additional requirement, which has little value in departmental work and career progression.[25] Some TMAs that originated from the former urban union councils have some sanitation staff who are responsible mainly for cleaning streets and removing solid waste in a limited urban area, leaving the vast majority of other areas with no sanitary staff. These staffers, called sweepers, perform duties at will and without any formal training or awareness of safe hygiene practices.

6. Poor Cost Recovery Mechanism

20. Many users want to have a higher level of service than is provided, particularly regarding the convenience of household connections. When the consumers do not get the desired level, they stop paying their water bills in frustration. This is compounded by the constant rise in costs arising largely from power tariffs that are steadily revised upwards without consideration of consumers' ability to pay. This leads to frustration, the lack of service, and the resulting nonpayment of bills for water and power.

21. Since early 1990, a number of efforts were made to improve the revenue collection mechanism in PHED, with encouraging results.[26] However, the efforts were short lived, primarily because water bills from all schemes were received in the provincial exchequer (or devolved after 2001 to the district exchequer) and not directly into PHED accounts. The provincial government makes annual financial allocations to PHED based on its work program, irrespective of revenue collection or cost recovery efforts. The PHED head office in turn makes suballocations irrespective of the revenue collected from a given field office or scheme. Cost recovery has remained a secondary or tertiary priority for PHED management. Primarily, the construction of new schemes and responding to crisis to maintain an ever-enlarging fleet of schemes were priorities for PHED. Water supply, being a sensitive political concern, would almost always get the PHED hefty budgetary allocations despite low cost recovery, until that was not possible anymore for provincial governments.

22. After devolution, revenue collection under TMAs has generally improved in limited urban areas served by TMA schemes. However, the vast majority of schemes remain under PHED control, and cost recovery has not seen any improvement. The TMAs are therefore in a precarious situation, with low revenues and lack of alternative funding on the one hand and the need to deliver an efficient water supply service on the other. The result has been customer and voter dissatisfaction and the creation of large deficits, with the eventuality of power supply cutting off because energy bills are not paid.

7. Contracts and Bidding System

23. The present system of contracting promotes the creation of contractors' lobbies in which individual contractors obtain contracts by personal favor. The principle of accepting lowest bids under this system does not necessarily translate into contract awards. The World Bank has recently prepared a document on improving governance in urban WSS, some of which may be applicable to rural WSS as well.[27]

[25] Feedback from discussions with PHED field staff and ex-project staff, September 2008.

[26] Communication with a large number of water supply and sanitation professionals based in international agencies in Islamabad and with government officials in Punjab and North-West Frontier Province.

[27] World Bank. 2008. *Deterring Corruption and Improving Governance in Urban Water Supply and Sanitation Sector*. A Source Book, Water Working Notes No. 18. Washington, DC.

8. Poor Utilization of Citizen Community Board Fund

24. Under the local government setup established after 2001 in Pakistan, many CBOs have been formed and registered as citizen community boards (CCBs).[28] The CCB formation and registration process is reportedly complicated and cumbersome, which had meant fewer CCBs being registered than their potential. As a consequence, almost all development funds at the disposal of CCBs remain unused.

III. THE PROJECTS

A. Punjab Rural Water Supply and Sanitation (Sector) Project

25. ADB approved a $46 million loan for the PRWSSP[29] on 31 January 1995 from its Special Funds resources, and the loan became effective on 23 August 1995. The depreciation of the Pakistani rupee against the United States dollar and savings in the actual cost of some equipment, materials, and training and consulting services resulted in $7.93 million of the loan being cancelled. The late recruitment of consultants, delayed appointment of a full-time project director, high consultant turnover, late completion of civil works, time taken by the government of Punjab to approve subprojects, and late electrification by the Water and Power Development Authority collectively led to a 2-year extension of loan closing date.

26. The PRWSSP aimed to provide least-cost and low-technology water supply and drainage schemes to selected communities in seven districts in rural Punjab. It had three components: (i) water supply and drainage construction in about 300 communities, (ii) a hygiene education program, and (iii) institutional strengthening support to PHED. It envisaged generating several direct and indirect benefits through the provision of safe and reliable water supply and improved sanitation facilities to 900,000 residents in about 300 rural communities. Significant savings in time spent fetching water would permit time for undertaking productive and social activities. The PRWSSP was expected to significantly reduce the incidence of waterborne illness, unsanitary conditions, and the child and infant mortality rates. The hygiene education program and institutional strengthening were expected to complement and reinforce the economic and health benefits associated with WSS and ensure that the initial gains could be sustained and enhanced. The PRWSSP estimated that the economic internal rate of return (EIRR) for the selected subprojects was higher than the 10% opportunity cost of capital, but the anticipated health benefits were not quantified. The PRWSSP did not have a design and monitoring framework. A mid-term review was planned but did not materialize. The project design emphasized a community participatory approach, and it was agreed that the provincial government would cover the full capital costs of the subprojects to be constructed and that each community, through its water-user committee, would manage, operate, and maintain its scheme to ensure that reliable, least-cost, and affordable service was provided to all user households. The tariff was to be set by each water-user committee to fully recover its O&M costs from user households.

27. The project completion report (PCR) noted that the project design was highly relevant to the Government's development strategy to improve rural WSS and ADB's strategy of supporting projects with potential to satisfy basic needs, reduce poverty, and improve the environment.

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[28] CCBs are recognized under the Local Government Ordinance of 2001 as formal community groups eligible to access local government funds for local development projects and service delivery.

[29] ADB. 1994. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Islamic Republic of Pakistan for the Punjab Rural Water Supply and Sanitation (Sector) Project*. Manila; and ADB. 2003. *Project Completion Report on the Punjab Rural Water Supply and Sanitation (Sector) Project in Pakistan*. Manila.

The PRWSSP was considered less effective because underachievement of outcomes brought 39% less coverage of households, inadequate water pressure, design and implementation problems, weak social mobilization, no disinfection facility, a reduced hygiene education program, and only partial achievement of institutional strengthening. The PRWSSP was rated less efficient in implementation because of the various delays encountered during start up, the recruitment of consultants and contractors, and the handover of the completed schemes. The report rated the PRWSSP less likely to be sustainable because of the (i) poor performance of operational entities and their inability to recover costs, (ii) lack of proper maintenance policy and procedures, (iii) minimal funds to cover continued O&M and growth requirements, (iv) lack of government ownership and commitment, and (v) low extent of community participation and beneficiary incentive to maintain project benefits. It stated that the PRWSSP had significant impacts on the environment and social organization, while few communities had taken self-help initiatives. It cited reduced incidence of waterborne diseases and improved high school enrolment. These impacts were, however, neither monitored, recorded, nor justified. The PCR rated the PRWSSP partly successful. The IED validated the ratings in the PCR.

B. Punjab Community Water Supply and Sanitation (Sector) Project

28. The design of the PCWSSP[30] followed from PRWSSP implementation lessons, and ADB approved a $50 million loan from its Special Funds resources on 28 November 2002, which became effective on 29 April 2003. ADB had earlier waived the appraisal for the project.[31] As per schedule, the loan closed on 30 June 2007.

29. The goal of the PCWSSP was to reduce poverty and improve living conditions and the quality of life in rural settlements in Punjab with water scarcity and/or brackish groundwater. The PCWSSP sought to (i) extend through a community-based and demand-driven approach water supply, drainage, and sanitation coverage to poor villages that did not have access to organized water supply and were located in brackish and dryland (barani) areas of Punjab; (ii) strengthen newly constituted TMAs and build their capacity to organize community-based water supply and drainage schemes and improve related management functions; (iii) implement a hygiene education program, including helping selected beneficiaries in the project *tehsils* construct household latrines through a revolving fund; and (iv) implement a social-uplift and poverty-eradication (SUPER) program to help use the time saved not fetching water in productive livelihood activities, particularly for women, through a microcredit system and by constructing additional classrooms in schools where enrollment had increased because children were released from the chore of fetching water. The PCWSSP covered 30 districts of Punjab and had planned to serve 750 communities—500 of them with new construction and 250 by rehabilitating inoperative schemes—servicing approximately 2.3 million people. The PCWSSP envisaged generating integrated benefits with the provision of safe drinking water to improve health and education with significant impact on poverty reduction, gender development, environmental improvement, and human resource development in the service areas. The PCWSSP was expected to (i) increase household incomes; (ii) save time in fetching water, particularly for girls; (iii) improve socioeconomic well-being; (iv) eliminate stagnant water bodies; (v) improve child care; (vi) promote girls' regular school attendance; (vii) lower morbidity rates; (viii) reduce infant mortality rates; (ix) reduce the incidence of waterborne disease; and (x) strengthen TMAs by improving their capacity. The EIRR was expected to be between 35.4% and 41.4% for the new

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30 ADB. 2002. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Islamic Republic of Pakistan for the Punjab Community Water Supply and Sanitation (Sector) Project*. Manila; and ADB. 2008. *Project Completion Report on the Punjab Community Water Supply and Sanitation (Sector) Project in Pakistan*. Manila.

31 Woolridge, J.M. 2000. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, Massachusetts: Massachusetts Institute of Technology Press.

pumping subprojects, 70.4% for gravity-based subprojects, and 98.0% for rehabilitation subprojects.

30. The PCR concluded that the PCWSSP was highly relevant, highly effective, highly efficient, and most likely sustainable, with an overall rating of highly successful. The impact of the PCWSSP was considered positive. IED validated the PCR[32] with a revised overall rating of successful based on ratings of relevant, highly effective, efficient, and likely sustainable. The validation report noted that the 2% upfront capital requirement and limitation of funds for water supply connection imposed constraints on the poorer households in subproject communities, and the PCWSSP had limited complementarity with other development partners. While the importance of hygiene education and SUPER was recognized, the size and scale of these two components in the PCWSSP had little influence on achieving other intended outcomes such as poverty reduction and hygiene awareness. The PCWSSP nevertheless exceeded its physical target with the provision of 778 subprojects. Cultural barriers limited the full participation of women in the decision-making process at all stages of the project cycle. While the CBOs generated savings, efforts were limited in mobilization them. High fuel costs and erratic power supply meant reduced hours of tubewell pump operation. The validation report concluded that the PCWSSP was likely to be sustainable if adequate attention was accorded to strengthening CBOs' maturity. IED concurred with the PCR that the impact was positive, particularly in terms of reduced drudgery associated with fetching water, the improved proximity of water supply, and the increased enrolment of girls in schools. The PCR did not assess hygiene practices.

IV. METHODOLOGY AND DATA FOR IMPACT EVALUTION AND SUSTAINABILITY ANALYSIS

A. Impact Evaluation

31. The conceptual framework for this study (Table 1) was guided by a literature review of WSS impact evaluation and a program theory that linked goal, resources, activities, output, outcomes, and impact.[33] The study focused on the impact of WSS interventions in three areas: (i) health, (ii) education, and (iii) labor force participation and hours worked. Several impact variables were considered in the study. It was assumed that WSS interventions would reduce the incidence and severity of waterborne diseases, thereby reducing health expenditures. Secondly, improved WSS would enable children to save time previously spent fetching water and enable more of them to go to school. Finally, it was hypothesized that time saved not fetching water could be used for generating income and gainful employment, either part or full time. As stated in Table 1, the incidence and intensity of diarrhea and back pain from fetching water represented health impacts. The incidence of diarrhea was recorded as a binary response, while the intensity of diarrhea was measured by the number of sick days. Similarly, back pain was noted as a binary variable. Education impacts were represented by four variables: (i) attendance at primary school, (ii) attendance at secondary school, (iii) households with children refusing to go to school for lack safe drinking water, and (iv) children refusing to go to school for lack of proper toilet facilities. All education impact variables were binary as well. Similarly, labor impact variables included labor force participation (binary) and average hours worked (continuous). The basic treatment variable was the presence or absence of a subproject supported by the project. The presence of a project referred to what is known in the literature as

[32] ADB. 2009. *Project Completion Report Validation of the Punjab Community Water Supply and Sanitation (Sector) Project in Pakistan*. Manila.
[33] A summary of WSS impacts based on literature review is provided in Appendix 5.

the "intention to treat" effect.[34] The other independent variables used in the control functions were those commonly used in the literature.[35] These included household, community, and individual characteristics, in cases where the individual is the unit of analysis (e.g., diarrhea incidence and labor variables). The household characteristics examined were the characteristics of the household head (e.g., age, sex, education, occupation, sector of work), household expenditures, housing characteristics, and household assets. Community characteristics included location dummies representing district, school, and health facilities, other development indicators (e.g., transport facilities), demographic characteristics (e.g., population, number of households), and main sources of livelihood. Age, sex, and education comprised individual characteristics. The study team developed data collection instruments and guidelines, and these were pretested and modified based on the feedback before conducting interviews (Supplementary Appendix A).

Table 1: Logic Model Demonstrating Impact of WSS Interventions

Project Inputs/Activities	Outputs	Project Outcomes	Project Impacts
Project Resources **Project Components**	**Water Services** **Sanitation Services** **Training and information on Water and Sanitation Practices**	**Access to Water Services** (i) Access to improved water (ii) Time spent in fetching water **Access to Sanitation Services** Sanitation at home	**Health** (i) Reduce incidence/intensity of waterborne diseases (diarrhea) (ii) Reduced drudgery (pains from fetching water)
Non-project factors **Household and individual characteristics** (i) Age, sex, and education of individual (ii) Age, sex, and education of household head (iii) Expenditure and wealth indicators (iv) Housing characteristics **Community characteristics** (i) Availability of health facilities (ii) Availability of education facilities (iii) Other water and sanitation facilities (iv) General development indicators		**Water Sanitation practices**	**Labor Supply** (i) Labor force participation and employment (ii) Hours worked **Education** (i) School attendance (ii) Children's refusal to go to school due to lack of clean water (iii) Children's refused to go to school due to poor toilet facilities

Note: The causal chain is from left to right.
Source: Based on literature review on water supply and sanitation.

32. The study applied a mixed-method approach to evaluate the impact of the WSS interventions that included key informant interviews, focus group discussions, and household

[34] One can use the households with piped water as the treatment to generate the effect of treatment on the treated. However, this is clearly an endogenous treatment variable. Estimation for endogenous treatment would require instrumental variable estimation for linear models; instrumental variable probit for discrete outcomes (footnote 31); and an instrumental variable–generalized method of moments approach for count models (Cameron, A. and P. Trivedi. 2005. *Microeconometrics: Methods and Applications*. New York: Cambridge University Press). The presence of a subproject in the village is a good instrument. It satisfies the conditions for instruments by being (i) directly related to the treatment and (ii) not related to the error term of the primary equation.

[35] Mosley, H. and L. Chen. 1984. An Analytical Framework for the Study of Child Survival in Developing Countries. *Population and Development Review*, Vol. 10, pages 25–45.

surveys.[36] PHED and TMA officials, school teachers, local health practitioners, religious leaders, and community leaders participated in the key informant interviews. The study team conducted focus group discussions with CBOs and face-to-face interviews with household members. In the absence of household baseline data, the study could not utilize the double difference method of comparisons "before and after" and "with and without," but was restricted to using the single difference method of estimation. Under this limitation, the counterfactual case was simulated using comparison communities, which were identified using 1998 district census reports. Communities were matched based on four key attributes: (i) total village area, (ii) number of households with potable water, (iii) average household size, and (iv) literacy rates. The list of comparison communities was agreed by knowledgeable local practitioners. It was assumed that the project communities, or "treatments," would have been identical to non-project communities in all respects except for the provision of WSS through ADB-funded projects. The study estimated impact in both ways identified in Jalan and Ravallion,[37] using difference in means and regression methods. Efforts were made to minimize spillover and spill-in effects, and this was supported by the similarities of most of the attributes of respondents, households, and communities.

33. The study area was 7 districts randomly selected from the 30 districts covered by the PRWSSP and the PCWSSP.[38] These seven districts accounted for 54% of study-eligible ADB-supported WSS subprojects. Four of the seven districts represent both the PRWSSP and the PCWSSP, and the remaining three were PCWSSP-only districts. Taking into account resource constraints and following Barlett et al.,[39] 115 subprojects were identified using stratified random sampling methods, accounting for due representation of typology of subprojects (PRWSSP versus PCWSSP, new construction versus rehabilitation, and water supply versus WSS).[40] PHED had handed over the O&M of all sample subprojects to their CBOs at least 12 months prior to the survey. The study team prepared a list of the names of the subprojects and corresponding number of households connected. In all, the sample for the household survey was 115 project and 115 comparison communities comprising a total of 1,301 treatment and 1,301 comparison households.[41] The number of sample households for each subproject was in proportion to its relative share in the total number of the households (Table 2). Appendix 6 contains detailed discussion of methodology and study design. The sample subprojects accounted for 10% of all subprojects under PRWSSP and PCWSSP, and 22% of subprojects in seven sample districts. Stratified random sampling procedure took into account the geographical, agro-ecological, and typology of subproject representation.

[36] The household questionnaire had 10 sections: (i) household identifiers; (ii) personal characteristics of individual household members or household roster; (iii) waterborne-related and other morbidity information; (iv) education; (v) employment and livelihood; (vi) water sources; (vii) sanitation facilities and practices; (viii) health education, community participation, and institutions; (ix) housing characteristics; and (x) household assets and expenditures.

[37] Jalan, J. and M. Ravallion. 2003. Does Piped Water Reduce Diarrhea for Children in Rural India? *Journal of Econometrics*. Vol. 112, pages 153–173.

[38] The PRWSSP and the PCWSSP had 335 WSS construction subprojects and 778 WSS rehabilitation subprojects covering 30 of 35 districts of Punjab, but the distribution across districts is uneven, with, 10 districts having fewer than 10 subprojects and another 4 having 11–14 subprojects. Seven districts were randomly selected from the remaining 16 districts.

[39] Barlett, H., J.W. Kotrlik, and C.C. Higgins. 2001. Organizational Research: Determining Appropriate Sample Size in Survey Research. *Information Technology, Learning and Performance Journal, Vol. 19(1):43–50*.

[40] There were only 16 sanitation-only subprojects, which were excluded from the analysis.

[41] The sample size included an additional 20% of households to cover for no response or incomplete surveys.

Table 2: Sampling Distribution

District	Total No. of Subprojects PRWSSP	PCWSSP	Total	No of Sample Subprojects PRWSSP	PCWSSP	Total	No. of Sample Households PRWSSP	PCWSSP	Total	Comparison Households	Grand Total
Rawalpindi	47	34	81	12	6	18	118	67	185	185	370
Chakwal	47	43	90	12	9	21	173	123	296	296	592
Bahwalpur	54	34	88	13	8	21	124	79	203	203	406
RY Khan	54	38	92	13	8	21	102	56	158	158	316
Sargodha		53	53	0	9	9	0	95	95	95	190
Fasialabad		40	40	0	7	7	0	76	76	76	152
DG Khan		82	82	0	18	18	0	288	288	288	576
Total	**202**	**324**	**526**	**50**	**65**	**115**	**517**	**784**	**1,301**	**1,301**	**2,602**

PCWSSP = Punjab Community Water Supply and Sanitation Project, PRWSSP = Punjab Rural Water Supply and Sanitation Sector Project.
Note: Each subproject represents one community.
Source: PCWSSP and PRWSSP project databases and information provided by the project staff in August 2008.

B. Sustainability Analysis

34. The sustainability analysis focused on two key aspects of the WSS projects: (i) technical and physical status and (ii) the capacity of CBOs responsible for subproject O&M. The analysis used a mixed-method approach involving (i) a technical survey of the same 115 subprojects selected for the household survey; (ii) focus group discussions with each of the 115 CBOs responsible for subproject O&M; and (iii) a knowledge, attitude, and practice (KAP) survey of 1,400 adults and children in project and comparison communities. The community questionnaire had five sections: (i) physical characteristics; (ii) demographic characteristics; (iii) basic services and institutions such as education, health, water, garbage and waste disposal, and transportation; (iv) other water and sanitation projects; and (v) electricity availability. The technical and CBO capacity assessment instrument had 10 modules: (i) CBO profile, (ii) training, (iii) institutional maturity index, (iv) community perception about access and quality of water, (v) O&M, (vi) quality of work, (vii) technical status, (viii) water quality, (ix) sanitary inspection, and (x) laboratory test report.

35. The sample technical survey data was used for assessing (i) the functional status of subprojects, (ii) the type of technology and nature of water sources, (iii) supplies or connections corresponding to the level of demand, (iv) the extent of illegal connection, (v) the quality of work, (vi) water sample analysis, and (vii) sanitary hazard assessment. Similarly, community and focus group discussion data were used for assessing the capacity of CBOs. A community organization maturity index was computed based on eight sets of attributes: (i) clarity and transparency of bylaws governing different aspects of WSS services; (ii) ability of community organizations to develop linkages and networks with other development partners to become broad based and sustainable; (iii) community organizations' records and documentation practices demonstrating their maturity and transparency; (iv) system of finance, accounts, and/or assets open to scrutiny to promote the trust and confidence of the beneficiaries; (v) inclusive and participatory management practice; (vi) improved capacity and skills of workers; (vii) ease and frequency of community interaction; and (viii) effective leadership qualities, style, and effectiveness. The KAP survey gathered information on KAP pertaining to hygiene practices for 700 project respondents and 700 comparison respondents, equally divided between male and female, adult and child. The detailed methodology used for sustainability analysis is provided in Appendix 6, and the instruments for data collection appear in Supplementary Appendix B.

C. Methodological Limitations

36. The study was conducted with some methodological limitations. The absence of baseline data for individuals and households limited the study to adopt a single difference "with

and without project" approach, rather than augmenting this with "before and after" to produce double difference comparisons. In the absence of usable baseline data, the comparison households were actually synthetic controls based on community attributes rather than real controls. While the differences between treatment and comparison households were minimized by controlling for relevant individual, household, and community characteristics, unobserved differences could not be controlled. With baseline data, the impact of time-invariant unobservable characteristics could have been removed. Also, comparison households and individuals could not be identified due to the unavailability of comparable rosters at the time of project intervention. However, the similarities of attributes of respondents and communities in project and comparison communities confirmed that matching at the community level was successful. The sustainability analysis is based on descriptive statistics collected during technical survey and focus group discussions with the CBO management teams.

V. RESULTS AND DISCUSSION

A. Impact Evaluation

37. Project impact was determined by first examining the simple differences in means and/or proportions of indicators of interest, such as access to markets, transport, energy, education facilities, etc., between project and non-project areas. Then multivariate regression models that control for the other important variables were estimated using the estimation methodology described in Wooldridge. According to the common modeling frameworks[42] the control variables included personal, household, and community characteristics. The personal characteristics include age, sex, and education. The household characteristics comprised the characteristics of the household head such as age, sex, education, occupation, and sector of work, as well as housing characteristics as a proxy for wealth indicators. The community characteristics included the presence of health facilities and other development indicators including demographic characteristics. Only multivariate estimation results are discussed in this section, given its superiority over comparison of means and/or proportions in establishing causality and estimating impact.

38. As the impact of a project on different socioeconomic groups is seldom uniform, analyses of different socioeconomic groups were conducted. The socioeconomic group indicator was the education attainment of the household head divided into three subgroups: (i) up to class 5, or primary; (ii) class 6–10, or middle and high school; and (iii) class 11 and above, or tertiary.[43] Finally, an important policy question was whether the project intervention type mattered to impact. Interventions were evaluated in three groups. First, there were two phases of the project—phase I or the PRWSSP and phase II or the PCWSSP—reflecting the duration of WSS intervention. Second, some subprojects had WSS components, while others had only water supply components. Finally, some projects provided entirely new infrastructure,

[42] See, for instance, (i) Mosley, H. and L. Chen. 1984. An Analytical Framework for the Study of Child Survival in Developing Countries. *Population and Development Review.* Vol. 10, *pages 25–45*: for a general framework discussing how personal, household, and community characteristics determine the child morbidity and mortality outcomes; (ii) Becker and Lewis. 1973. On the Interaction between the Quantity and Quality of Children. *Journal of Political Economy.* Vol. 81(2), pages S279–288: for human capital investments in children; (iii) Becker, G. 1965. A theory of the allocation of time. *Economic Journal.* Vol. 75, pages 493–517; and (iv) Gronau, R. 1977. Leisure, Home Production, and Work: Theory of the allocation of time revisited. *Journal of Political Economy.* Vol. 85, pages 1099–1123 for time allocation models.

[43] Admittedly, income or expenditure is the more popular indicator of socioeconomic status. Using it would be problematic, however, because it is endogenous. The education of the household head, on the other hand, highly correlates with household income but can be considered exogenous because it was mostly likely earned before the project.

while others rehabilitated old infrastructure. Consistent with the evaluation design, only analyses using matched project and comparison villages are discussed here.[44]

39. The quantitative analysis results are presented in three parts: (i) major attributes of communities, households, and respondents from the project and comparison areas; (ii) intermediary project outcomes; and (iii) project impact on health, education, and labor force participation and hours worked. Data collected for the study is available in Supplementary Appendix C. Detailed estimation results are summarized in Appendix 7, and full estimation results appear in Supplementary Appendix D.

1. Attributes of Project and Comparison Communities, Households, and Respondents

40. The project (treatment) and comparison (control) communities were found to be statistically similar in most aspects, including public facilities such as schools (except for primary schools), garbage collection and disposal, transportation, population, and major livelihood sources. The two exceptions were the presence of a water supply system and relatively better access to primary education in the project communities. Ninety-two percent of the project communities had a community water supply system, while only 8% of comparison communities did. A smaller proportion of households depended on hand pumps in project areas than in the comparison communities (24% versus 54%); while proportionately more households were served by tubewells in project areas than non-project areas (40% versus 24%). As a higher percentage of project communities had a primary school than did comparison communities (97% versus 87%), the distance to primary and middle schools was shorter in project than in non-project areas.[45] Almost all households surveyed in both project and comparison communities enjoyed access to electricity, when available. Occupationally, both groups were similar, dominated by cropping (60%), followed by trading (14–17%), livestock (12%), manufacturing (3%) and selling labor (9–10%). The respondent and household characteristics in the project and comparison communities were similar except for housing conditions. The project households had more sleeping rooms and improved floors than their non-project counterparts. The similarities of project and comparison communities reflect the conscious selection of comparison villages matching each of the project intervention communities.

2. Intermediate Project Outcomes: Water and Sanitation

41. The Intermediate project outcomes assessed in the study comprised (i) access to water and sanitation; (ii) reliance on water source; (iii) time spent and distance traveled in fetching water; and (iv) per capita monthly household expenditure on water. The results indicate that a significantly higher proportion of households in the project areas than in comparison communities had water available on the premises and for all purposes. Nearly 71% of project households had piped water in their dwellings, compared with only 10% of comparison households, the majority of whom relied on hand pumps and bore holes. Very few households depended on wells or rainwater in either area, but significantly more among comparison households. A small proportion of project households depended on water sources outside their household premises. These project households spent two thirds less time and traveled less than two thirds as far in fetching water than did their comparison counterparts. The per capita monthly expenditure on water for all purposes, including drinking, was found to be 28.5% lower in project areas than the comparison areas (Rp22.58 versus Rp31.32). Drinking water alone

[44] Analysis using only data from project villages was also done.
[45] The difference in mean was statistically significant at 1%.

accounted for a high proportion of water costs in both areas (80% versus 82%), and an average project household spent 21% less on drinking water than an average comparison household. The results confirming improved access to water were consistent with PCR findings of project households' improved accessibility to water.

42. The results do not show marked differences in access to sanitation between project and comparison communities. Four in five households had a toilet facility on their premises, but only a little more than one fourth of them had covered sewers. All households in both treatment and comparison areas reported using one or more form of cleaning agents for hand washing. The result is not surprising because project input was insufficient to bring about additional changes. Further, there may have been other community- or household-led initiatives to improve access to toilet facilities independent of project activities. The relatively low adoption of covered sewers may reflect the lack of adequate emphasis on demonstrating their benefits and/or the inability of communities or households to afford them.

3. Project Impact on Household Welfare

a. Impact on Health

43. Health impact was evaluated in terms of (i) the incidence of waterborne illness, diarrhea in particular, and (ii) the reduction in drudgery associated with fetching water, as well as muscle strain, blisters, heat stroke, and back pain by the sample household members. The study examined the incidence of diarrhea and the resulting number of sick days. The incidence of diarrhea in the study areas was found to be 1.8% for all ages and 6% for children 5 years and under. These figures are substantially lower than figures reported in other studies.[46] Four weeks prior to the survey date was used as a reference point to record the incidence of diarrhea because the survey took placed in August–October 2008, which had a long dry spell.

44. Table 3 shows that aggregate diarrhea incidence and the severity of illness, measured by the number of sick days for all members, including children 5 years and under, were not significantly different between project and non-project areas. These results do not lend support to the claim in the PCR (para. 31) of the PCWSSP that the project was successful in reducing the incidence of waterborne diseases. But they are consistent with the earlier results in Fewtrell and Colford,[47] and the village-level matching result in Jalan and Ravallion (footnote 37), which reported no significant impact on health from water supply interventions. The low incidence of diarrhea in the sample households may have made it difficult for the PCWSSP to cause further improvement, perhaps because of (i) the prolonged dry spell, (ii) greater public awareness of safe water (boiled water) consumption and hygiene practices, and/or (iii) other preventive measures taken by households in both project and comparison areas. In addition, diarrhea may not necessarily be associated with the provision of drinking water in study areas, and it may occur when there is any contact with infectious sources. Even though bacteriological contamination was high, both at water source and consumption point, since most of the

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[46] National Institute of Population Studies (Pakistan), and Macro International Inc. 2008. *Pakistan Demographic and Health Survey 2006–2007*. Islamabad. Pakistan estimated that the incidence of diarrhea in children below 6 years of age in Punjab was 21% in 2006–2007, and the Pakistan Social and Living Standards Measurement Survey conducted by the Government of Pakistan reported that 11% of the children 5 years of age and under in rural areas of Punjab suffered from diarrhea in 2006–2007. In both studies, the incidence of diarrhea recorded was within 2 weeks preceding the survey date.

[47] Fewtrell, L. and J. Colford. 2004. Water, Sanitation and Hygiene: Intervention and Diarrhea: A Systematic Review and Meta Analysis. *Health Nutrition and Population DP* No. 34960. World Bank: Washington, DC.

households boiled water for drinking purposes and, hence, this may not have led to increase in diarrhea incidence.

Table 3: Impact of Water Supply and Sanitation Intervention on Health

Health Impact	Impact Estimate	Significance Level
A. Waterborne Disease		
Diarrhea incidence, All ages	0.002 [a]	0.521
Diarrhea incidence, 5 and under	0.003 [a]	0.812
Diarrhea sick days, All ages	0.853 [b]	0.167
Diarrhea sick days, 5 and under	0.901 [b]	0.727
B. Drudgery		
Pain from fetching water[c]	(0.051) [b]	0.000

( ) = negative.
Notes: [a] Marginal effect; [b] incidence rate ratio; [c] Pain from fetching water refers to muscle strain, backache, and blisters.
Source: Supplementary Appendix D.

45. While the aggregated analysis masked the project's health impact on different socioeconomic groups of respondents, a disaggregated analysis demonstrated that the middle socioeconomic group actually experienced a reduction in the incidence of diarrhea among household members of all ages, but the lowest and highest socioeconomic groups did not (Table 4).[48] This result is somewhat surprising, and there could have been other factors such as households' participation in hygiene education and food safety activities. This finding differs somewhat from Gross et al.,[49] who noted that there was no differential impact of water supply on diarrhea between lower and upper socioeconomic groups. No significant impact on the health of children under 5 across all socioeconomic groups implies that the households may have adopted standard practices to make water safe to drink. Also, no significant differences were found in the incidence of diarrhea or the number of sick days by project type—PRWSSP versus PCWSSP, new construction versus rehabilitation, and water supply versus WSS (Table 5). The results suggest that water quality, with the exception of bacteriological contamination, was of a reasonable standard and that households took adequate preventive measures in handling water. Other national and provincial health programs independent of project activities may have contributed to substantially lower the incidence of waterborne diseases. Lower incidence of diarrhea meant fewer sick days. The results do not lend support the hypothesis that the project intervention had tangible impact on waterborne diseases.

[48] There were three socioeconomic groups based on the educational attainment of the head of the household: (i) lowest (education up to 5 years of schooling), (ii) middle (6–10 years of schooling), and (iii) highest (more than 10 years of schooling). See Mincer, J. 1974. *Schooling, Experience, and Earnings*. National Bureau of Economic Research. New York.

[49] Gross, R., B. Schell, M.C. Molina, M.A. Leao, and U. Strack. 1989. The Impact of Improvement of Water Supply and Sanitation Facilities on Diarrhea and Intestinal Parasites: A Brazilian Experience with Children in Two Low-Income Urban Communities. *Revista de Saude Publica*, Vol. 23(3), pages 214–220.

Table 4: Impact on Health by Socioeconomic Group

Health Impact	Marginal Effects on Socioeconomic Group		
	Lowest	Middle	Highest
A. Waterborne Disease			
Diarrhea incidence, All	0.005	(0.01) [a]	(0.00)
Diarrhea incidence, 5 and under	0.009	(0.02)	0.01
Diarrhea sick days, All	0.813	1.133	1.092
Diarrhea sick days, 5 and under	0.943	0.821	0.983
B. Drudgery			
Pain from fetching water	(0.039) [b]	(0.011)	(0.037)

( ) = negative.
Note: [a] and [b] represent significance at 5% and 1%, respectively.
Source: Supplementary Appendix D.

46. The projects have had a statistically significant impact on the second measure of health, reduction in drudgery (represented by muscle strain, blisters, or backache) experienced by household members fetching water. In aggregate, the projects reduced this incidence by 5.1% in project areas over comparison areas (Table 3).[50] The impact was more pronounced in the lowest socioeconomic group (Table 4). The reduction in drudgery was more noticeable in PRWSSP areas than in PCWSSP areas (12.3% versus 5.4%). The results suggest that site selection for the PRWSSP served more needy communities than for the PCWSSP. Similarly, drudgery reduction was significantly greater in WSS subproject areas than in water supply areas (7% versus 4%). Respondents benefiting from newly constructed subprojects experienced greater reduction in drudgery than their counterparts benefiting from rehabilitation subprojects (6.8% versus 1.9%) (Table 5). The underlying reasons associated with varied drudgery impact by type of subproject (WSS versus water supply and new versus rehabilitated) could not be established.

4. Impact on Education

47. The project impact on education was measured in three ways: (i) school attendance by age group, (ii) households with children refusing to go to school for lack of clean drinking water, and (iii) households with children refusing to go to schools for lack of or poor toilet facilities. The projects had positive impact on school enrolment. The survey estimates on school enrolment were on the high side compared with other estimates for Punjab.[51] The study found that significantly fewer project households had children not going to school for lack of clean water than did households in comparison areas (2% versus 4%). On the other hand, there was no significant difference in the proportion of households with children not going to school for lack of toilet facilities in project and non-project areas, with the proportion being 4–5%.

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[50] Based on probit regression results, the impact of the projects is given by the marginal coefficients. Note that the regression estimates simply replicated the results of the comparison of means, indicating that there were no confounding impacts from the other determinants. Even the estimate of the impact on drudgery is virtually identical.

[51] The net primary attendance rate based on the Demographic and Health Survey 2007–2006 was 75.0% for both sexes, or 76.5% for males and 73.2% for females. For middle and/or secondary, the estimated net enrolment rate for Punjab was 31.2% for both sexes, or 31.9% for males and 30.6% females. Based on the Pakistan Social and Living Standards Measurement Survey 2006–2007, the total net primary enrolment rate in Punjab Province was 66%, or 67% for males and 65% for females. For middle school, the net enrolment rate was estimated at 34% for both sexes, or 36% for males and 32% for females.

Table 5: Impact on Health, Education, and Labor Supply Outcomes by Type of Project; Matched Villages

		PRWSSP		PCWSSP		WSS		WS		NEW		Rehab.	
Item		**Diff. in means or prop.**	**Multivariate**	**Diff. in means or prop.**	**Multivariate**	**Diff. in means or prop.**	**Multivariate**	**Diff. in means or prop.**	**Multivariate**	**Diff. in means or prop.**	**Multivariate**	**Diff. in means or prop.**	**Multivariate**
A. Health Impact													
Waterborne Diseases													
Diarrhea incidence,	All ages[a]	(0.0002)	(0.0002)	0.0004	(0.0021)	0.0014	0.0018	(0.0012)	0.0009	0.0009	0.0013	(0.0013)	0.0010
	5 and under[a]	(0.0209)	(0.0002)	0.0068	0.0156	(0.0057)	(0.0036)	(0.0006)	0.0196	(0.0011)	(0.0020)	(0.0082)	(0.0028)
Diarrhea sick days,	All ages[b]	(0.3478)	1.1280	(0.3055)	0.7460 [e]	(0.7128)	0.8040	0.0155	0.8320	(0.6508)	0.8560	0.3314	1.0360
	5 and under[b]	0.9000	2.6980	(0.8792)	0.8700	0.6385	1.2790	(1.0400)	0.7800	(0.5144)	0.6860	0.3571	1.5530
Drudgery													
Pain from fetching water	[a]	(0.1180) [f]	(0.1227) [f]	(0.0077)	(0.0054)	(0.0631) [f]	(0.0700) [f]	(0.0397) [f]	(0.0397) [f]	(0.0676) [f]	(0.0677) [f]	(0.0110)	(0.0189)
B. Education Impact													
Proportion attending by age group[a]													
All	6–24 years [a]	(0.0164)	(0.0989) [f]	0.0297	0.0119	0.0128	(0.0290)	0.0099	0.0029	0.0080	(0.0267)	0.0199	0.0067
	6–10 years [a]	(0.0679)	(0.1629) [f]	0.0908 [f]	0.1121 [f]	0.0158	(0.0188)	0.0475	0.0397	0.0011	(0.0331)	0.0987 [e]	0.0903 [e]
	11–17 years[a]	0.0578	0.0469	0.0808 [f]	0.0454	0.0680 [e]	0.0609	0.0750 [e]	0.0261	0.0535	0.0116	0.1226 [f]	0.0833
	18–24 years[a]	(0.0213)	(0.1046) [f]	0.0300	(0.0060)	(0.0070)	(0.0534)	0.0277	0.0133	(0.0062)	(0.0525) [e]	0.0462	0.0612
Female	6–24 years [a]	(0.0107)	(0.1092) [e]	0.0361	0.0264	0.0116	(0.0382)	0.0233	0.0318	0.0276	(0.0181)	(0.0083)	(0.0191)
	6–10 years [a]	(0.0540)	(0.2154) [f]	0.0519	0.1245 [e]	(0.0009)	(0.0472)	0.0243	0.0686	0.0226	(0.0234)	(0.0104)	0.0015
	11–17 years[a]	0.0730	(0.0101)	0.0893 [e]	0.1176	0.0864 [e]	0.0531	0.0783	0.0957	0.0678	0.0213	0.1241 [e]	0.0830
	18–24 years[a]	(0.0525)	(0.1043) [e]	0.0303	(0.0348)	(0.0275)	(0.0510)	0.0237	(0.0007)	(0.0028)	(0.0397)	(0.0090)	(0.0313)
Male	6–24 years [a]	(0.0014)	0.0179	0.0546 [e]	0.0413	0.0438	0.0586	0.0192	0.0135	0.0167	0.0052	0.0703	0.0824
	6–10 years [a]	(0.0497)	0.0655	0.1005 [f]	0.1064	0.0395	0.0712	0.0498	0.0472	(0.0043)	0.0432	0.1526 [f]	0.0541
	11–17 years[a]	0.0185	(0.1054)	0.0720	0.0055	0.0349	(0.0895)	0.0649	0.1091	0.0192	(0.1825) [e]	0.1374 [f]	0.1341
	18–24 years[a]	0.0413	(0.0320)	0.0199	(0.0279)	0.0356	0.0164	0.0198	(0.0221)	0.0074	(0.0366)	0.0729	0.0370
Household reporting children not going to school due to lack of water (proportion)[a]		(0.0464) [f]	(0.0384) [f]	0.0013	(0.0016)	(0.0315) [**]	(0.0355) [f]	(0.0032)	(0.0049)	(0.0236) [f]	(0.0274) [f]	(0.0028)	(0.0193) [e]
Household reporting children not going to school due to lack of toilet (propotion)[a]		(0.0426) [f]	(0.0371) [e]	0.0180	0.0107	(0.0270) [*]	(0.0405) [f]	0.0159	0.0139	(0.0225) [e]	(0.0306) [f]	0.0358 [e]	0.0135
C. Labor Supply Impact													
Labor force participation rate (Respondents proportion with job)[a]													
	10 years and above[a]	(0.0094)	(0.0092)	(0.0060)	(0.0065)	(0.0111)	(0.0111)	(0.0033)	(0.0031)	(0.0114)	(0.0100)	0.0032	0.0004
	11–17 years[a]	(0.0011)	(0.0168)	(0.0248) [e]	(0.0164)	0.0099	0.0048	(0.0442) [f]	(0.0410) [f]	(0.0162)	(0.0143)	(0.0145)	(0.0097)
	18–24 years[a]	(0.0093)	(0.0440)	(0.0334)	(0.0320)	(0.0483) [e]	(0.0551)	0.0026	0.0003	(0.0216)	(0.0237)	(0.0228)	(0.0446)
Hours worked per week													
	10 years and above[c]	0.9452	1.7499	(0.1911)	(0.8968)	0.3277	2.0188	0.4484	(1.3960)	(0.0215)	(0.1039)	1.1330	3.6723
	11–24 years[d]	4.1042 [e]	4.4021	(0.6511)	20.4064	2.8980	(29.1879)	(0.0115)	69.5411	1.0464	(37.2017)	2.1532	36.7615

( ) = negative, Coef. = coefficient, Diff. = difference, PCWSSP = Punjab Community Water Supply and Sanitation (Sector) Project, PRWSSP = Punjab Rural Water Supply and Sanitation (Sector) Project, Rehab. = rehabilitated, WS = water supply, WSS = water supply and sanitation.

Notes: [a] Marginal effects; [b] Incidence rate ratio; and [c] Coefficients.

Source: Independent Evaluation Department estimation based on data collected for the study, and Supplementary Appendix D.

48. Estimation results show that the projects significantly increased school enrolment, particularly in middle and high schools (14–17 year olds), and the project areas had 5% higher enrolment than comparison areas. The impact was more pronounced for girls, reflected by an increase in enrolment by 8.2% (Table 6), and the impact for boys in the same age group was statistically insignificant.[52] The findings support the hypothesis that girls in older age groups who save time with improved access to water are likely to go to school. The results suggest that older girls were more involved in fetching water than the younger ones and therefore benefited the most.

Table 6: Impact of Water Supply and Sanitation Intervention on Education

Impact on School Enrolment		Marginal Effects	Significance Level
Proportion enrolled by age group			
All	6–24 years	(0.008)	0.676
	6–10 years	0.028	0.282
	11–13 years	0.046	0.135
	14–17 years	0.053	0.092
	18–24 years	(0.016)	0.468
Female	6–24 years	0.002	0.929
	6–10 years	0.019	0.610
	11–13 years	0.068	0.136
	14–17 years	0.084	0.061
	18–24 years	(0.036)	0.164
Male	6–24 years	0.038	0.163
	6–10 years	0.038	0.437
	11–13 years	(0.072)	0.475
	14–17 years	0.110	0.113
	18–24 years	0.008	0.843
Household reporting children not going to school due to lack of water (proportion)		(0.018)	0.006
Household reporting children not going to school due to lack of toilet (proportion)		(0.011)	0.205

( ) = negative.
Source: Supplementary Appendix D.

49. The disaggregated analysis provided a somewhat different picture. Table 7 suggests that children's enrolment in school increased by 10.6% for the middle socioeconomic group but deceased by 8.2% for the lowest socioeconomic group's older children (18–24 years old). This may mean that time freed up from fetching water could have been used to undertake economic and/or social activities, including leisure and the care of younger siblings. On the other hand, enrolment increased for children of all ages in the middle socioeconomic group, ranging from 9.8% for 6–10 year olds to 11.8% for 11–13 year olds and more than 14% for young persons over 13 years of age. The results imply that the middle socioeconomic group faced fewer constraints than other groups in terms of sending children to schools and could readily tap into opportunities created by improved access to water in favor of children's education.

50. Gender-disaggregated data further suggest that school enrolment in the lowest socioeconomic group was statistically lower in project areas than in comparison areas for girls 18–24 years old (by 6.7%), while no significant changes were observed for boys in any age

[52] Statistical significance occurred only at the 10% level and reflected somewhat weak association.

group (Table 7) in the same socioeconomic group. On the other hand, in the middle socioeconomic group, enrolment increased significantly for boys in older age groups (11–13, 14–17, and 18–24 years) by wide margins, but the same results were valid for girls only aged 6–10 and 14–17. The results suggest that older girls in the lowest socioeconomic group may have been withdrawn from school for other reasons such as economic hardship, the need for household help, and/or social taboos, despite improved access to water. The increased enrolment of children in the middle socioeconomic group reveals that time would have been a key constraint on school attendance.

51. Analysis by project type revealed that girls' enrolment in school actually declined significantly in the PRWSSP areas, by 16.3% in the 6–10 year old group and by 10.5% in the 18–24 year old group (Table 5). On the other hand, enrolment increased in PCWSSP areas by 12.5% for 6–10 year old girls and by 11.8% for 11–17 year old girls. No marked changes were observed in boys' enrolment in any age group. The results are not surprising because PRWSSP communities are relatively remote and have fewer resources and opportunities than the PCWSSP communities. Similarly, whether the subproject was water supply only or WSS, as well as new or rehabilitated, had no significant impact on the school enrolment of either boys and girls, except in that 11–17 year old boys faced an 18.3% reduction in enrolment under new subprojects. No convincing reason was found for boys' enrolment decline.

Table 7: Project Impact on Education by Socioeconomic Group and Gender

	Marginal Effects on Socioeconomic Group		
Impact on School Enrolment	**Lowest**	**Middle**	**Highest**
All (by age group)			
6–24 years	(0.054)	0.106 [a]	0.043
6–10 years	(0.004)	0.098 [a]	(0.029)
11–13 years	0.006	0.118 [a]	(0.023)
14–17 years	(0.010)	0.148 [a]	0.044
18–24 years	(0.082) [a]	0.144 [a]	0.108 [b]
Female			
6–24 years	(0.032)	0.079 [b]	0.031
6–10 years	(0.030)	0.133 [a]	0.006
11–13 years	0.074	0.037	(0.157)
14–17 years	(0.003)	0.200 [a]	0.090
18–24 years	(0.067) [b]	0.053	0.090
Male			
6–24 years	(0.009)	0.120 [a]	0.015
6–10 years	0.002	0.122	(0.023)
11–13 years	(0.117)	0.187 [b]	0.020
14–17 years	(0.011)	0.313 [a]	0.153
18–24 years	(0.068)	0.156 [b]	0.136
Household reporting children not going to school due to lack of water (proportion)	(0.021) [b]	0.009	(0.003)
Household reporting children not going to school due to lack of toilet (proportion)	(0.013)	0.005	(0.002)

( ) = negative.
Note: [a] and [b] represent significance at 1% and 5%, respectively.
Source: Supplementary Appendix D.

52. The results suggest that, although the numbers were small, the projects contributed to a 1.8% increase in the number of households sending their children to school because of the improved availability of water (Table 6), but these children belonged mostly to the lowest socioeconomic group (Table 7). Children from these households had earlier refused to go to school for lack of adequate water there. The impact was more pronounced in PRWSSP areas than in comparison areas (Table 5), meaning that efforts to increase school enrolment by providing water supply in schools worked in PRWSSP areas but not in PCWSSP areas. The result may reflect the relevance of targeting the intervention in terms of providing water supply to selected schools. Similarly, WSS subprojects were more successful in encouraging households to send their children to school than subprojects for only water supply. Further, the impact was greater from subprojects with new construction than with rehabilitation.

53. Overall, the provision of toilet facilities in schools did not significantly contribute to the increase in enrolment of boys or girls in any age group. However, the impact was positive and significant in PRWSSP, WSS, and new construction subproject areas (Table 5). This may indicate that the provision of toilets in schools was better targeted under the PRWSSP than under the PCWSSP. Further, the criteria for providing toilets under the projects may not have been robust. Toilet construction in schools may have followed national and/or provincial education facility development covering both project and non-project communities.

5. Impact on Labor Force Participation and Hours Worked

54. In the absence of reliable income data, the economic impact of the projects was assessed in terms of impact on labor activity, with the assumption that increased participation and longer hours worked thanks to improved access to water would serve as proxies for economic impact. Hence, the impact of projects on labor activity was assessed in terms of young household members' participation in the labor force and the average number of hours worked in a week.[53] It excludes direct employment under the projects.

55. Household survey data suggested that, on average, the labor force participation rate was around 30% for people aged 10 years and above, 4–6% for the 11–17 age group, and 24–26% for the 18–24 age group. Employed young persons worked for more than 50 hours a week. However, the analysis based on pooled data suggested no statistical difference between the project and comparison communities' respondents (Table 8). On the other hand, when disaggregated by socioeconomic group, the middle socioeconomic group experienced significantly lower labor force participation than their comparison counterparts (Table 9). The 11–17 and 12–18 age groups had lower labor force participation rates, reduced by 3.8% and 9.8% respectively, and the 11–17 age group worked 14 hours per less per week. The result is consistent with the education impact, as some of the children who worked earlier may have opted for going back to school. No significant impact was observed on labor activity in the lowest and highest socioeconomic groups or the number of hours worked per week. It should be noted that hours worked was already high and there may not have been interest in extending labor force participation or hours worked. In addition, other confounding factors may determine labor force participation and hours worked per week.

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[53] Using hours worked in the past week as a reference.

Table 8: Impact on Labor Force Participation and Work Hours

Labor Supply Impact	Impact Estimate	Significance Level
Labor force participation rate (respondents proportion with job)		
10 years and above	(0.006) [a]	0.489
11–17 years	(0.014) [a]	0.136
18–24 years	(0.018) [a]	0.354
Hours worked per week		
10 years and above	0.613 [b]	0.719
11–17 years	59.013 [b]	0.899
18–24 years	(98.986) [b]	0.388

( ) = negative.
Notes: [a] Marginal effects, [b] Coefficients.
Source: Supplementary Appendix D.

Table 9: Impact on Labor Supply by Socioeconomic Groups

	Marginal Effects on Socioeconomic Group		
Labor Supply Impact	**Lowest**	**Middle**	**Highest**
Labor force participation rate (Respondents proportion with job)			
10 years and above	0.001	(0.020)	0.003
11–17 years	0.002	(0.038) [a]	(0.013)
18–24 years	0.022	(0.098) [a]	(0.021)
Hours worked per week			
10 years and above	0.793	0.348	(2.265)
11–17 years	25.790	(14.168) [b]	(30.982)
18–24 years	(95.982)	(0.405)	(0.833)

( ) = negative.
Note: a and b represent significance at 1% and 5%, respectively.
Source: Supplementary Appendix D.

56. The subproject type had no impact on labor activity, with two exceptions. Participation was significantly lower for 18–24 year olds in WSS subprojects and 11–17 year olds in water supply subprojects. This is likely associated with increased school enrolment. The evaluation findings do not support the hypothesis that time freed up from fetching water was used to generate income. However, children, particularly girls, were more likely to go to school if it was culturally permissible in the target community. While this was not quantified, some of the stakeholders and key informants argued that reduced drudgery and time saving had contributed to more leisure time for older children aside from school attendance. Leisure time was spent resting and on social interaction and caring for younger siblings. The lack of evidence that another add-on component, SUPER, had any uptake in the community further reinforces that the projects did not contribute to increasing household income using time saved from fetching water.[54] Further, high underemployment and lack of new employment opportunities could have

[54] Only 3.1% of the respondents undertook income generation as a result of the project, linking up with microfinance institutions. At the time of the interviews, most of the borrowers were not sure about the role played by the project except that it had introduced them to these institutions. Most of them had no clear idea about the impact of this income generation. Some had already abandoned their enterprise, while others had to sell fixed assets to repay their loan.

contributed to there being no significant project impact on labor force participation and hours worked.

6. Summary of Impact Evaluation

57. The study shows that, while the projects had clear and large influence on the intermediate outcomes (e.g., access to water supply), their impact on health was consistently revealed in the drudgery or pain from fetching water. However, this impact was found only in the lower socioeconomic group, not in the higher and middle groups. The higher socioeconomic group was likely to have a helper for fetching water, while lower socioeconomic household members did it themselves. The impact on primary health measures (e.g., diarrhea incidence and severity) did not turn out to be significant on average, though there were cases where significant reduction was found, such as in diarrhea incidence for all ages in the middle socioeconomic group. There was a clear increase in school attendance, particularly in high school, because of the projects. It is noteworthy that a statistically significant positive impact in this age group existed for girls but not for boys. This positive impact on school attendance was found only in the middle socioeconomic group. Regarding labor force participation and work hours, the projects had no significant impact on average, though when disaggregated a significant but negative impact was found in the middle socioeconomic group. Thus, higher school attendance rates either came from the withdrawal of working children from the labor force, particularly in the middle socioeconomic group, or from the reduction of time spent fetching water. The lack of impact on labor force participation and work hours indicates that the time saved from fetching water documented in the study had not been translated into more income generation, contrary to the expectation of project designers. Thus, the benefits of the projects came in the form of (i) reduced drudgery, particularly for the lower-income group; (ii) increased attendance rates in high school, particularly for girls in the middle socioeconomic group; and (iii) an increase in leisure through the reduction in time spent fetching water that did not result in increase in labor force participation or more hours worked. Detailed findings are summarized in Appendix 7.

B. Sustainability Analysis

58. The sustainability of project impacts depends on the likelihood of the sustainability of project interventions. In the study context, it refers to the sustainability of WSS infrastructure; capacity of CBOs responsible for managing, operating, and maintaining infrastructure; and effectiveness of hygiene education and SUPER activities. Project data show that civil works accounted for more than 70% of the project costs in both projects, followed by equipment and materials taking up 10–13% (Table 10). The institutional strengthening component share was 9.7% in the PRWSSP but only 1.1% in the PCWSSP, despite the renewed focus on actively engaging CBOs. Hygiene education received an initial allocation of $361,000 under the PRWSSP and $521,000 under the PCWSSP, but only $8,000 and $80,000 were disbursed, respectively, for the intended purpose. The allocation for an add-on component, SUPER, under the PCWSSP was reduced from $626,000 to barely $83,000. According to the project staff, resource reallocation was done based on project needs and revised cost estimates. However, the evaluation of focus group discussions and key informant interviews found evidence to the contrary and noted that the reallocation made the affected project components less effective.

Table 10: Original, Last Revised, and Actual Disbursement of Project Resources

	PRWSSP						PCWSSP				
	Original		Last revised		Actual		Original		Last revised		Act
Expenditure Category	Amount ($'000)	%	Amount ($'000)	%	Amount ($'000)	%	Amount ($'000)[a]	%	Amount ($'000)[a]	%	Amount ($'000)[a]
Civil works - part A	21,300	49.6	29,576	75.9	26,379	78.0	37,754	72.4	36,904	70.8	36,864
Equipment and materials - part A	14,492	33.7	3,742	9.6	3,600	10.6	6,046	11.6	8,715	16.7	6,692
Hygiene Education - part B	361	0.8	361	0.9	8	0.0	521	1.0	80	0.2	79
Institutional strengthening - part C	5,793	13.5	4,268	11.0	3,284	9.7	2,084	4.0	673	1.3	563
Service charge	1,028	2.4	1,028	2.6	565	1.7	1,856	3.6	1,398	2.7	1,221
Incremental administrative costs							2,084	4.0	3,170	6.1	3,881
SUPER							626	1.2	33	0.1	32
Interest during construction							1,146	2.2	1,146	2.2	804
Total	**42,973**	**100.0**	**38,975**	**100.0**	**33,836**	**100.0**	**52,117**	**100.0**	**52,117**	**100.0**	**50,135**

IMF = International Monetary Fund, PCR = project completion report, SDR = special drawing rights, SUPER = Social Uplift and Poverty Eradication Program.

[a] Converted from SDR using 1.37567 USD/SDR as of 29 April 2003 (effectivity of the project), IMF website.

Sources: ADB. 2003. *Project Completion Report on the Punjab Rural Water Supply and Sanitation (Sector) Project in Pakistan*. Manila; and ADB. 2008. *Project Completion Report on the Punjab Community Water Supply and Sanitation (Sector) Project in Pakistan*. Manila.

59. Table 11 shows a distribution of sample subprojects[55] covered by the study. They show proportional distribution of the total number of subprojects completed by the two projects. Accordingly, 80% of subprojects are new construction, and 20% are rehabilitated water supply systems. Only the PCWSSP had rehabilitation subprojects, 58% of which were WSS and 42% were only water supply. The PRWSSP subprojects have been on the ground for longer, at 87 months, than the PCWSSP ones, at 34 months. The analysis presented in this report has taken this background into consideration. The sustainability analysis is based on data collected during (i) technical survey of subprojects, (ii) focus group discussions with CBOs for assessing community capacity, and (iii) KAP surveys of adults and children in project communities. Detailed findings are reported in Appendix 8.

Table 11: Distribution of Sample Subprojects by Typology

	PRWSSP			PCWSSP			Total		
Item	**WS**	**WSS**	**Total**	**WS**	**WSS**	**Total**	**WS**	**WSS**	**Total**
Rehab.									
Ave. mos. since hand over				32.7	31.8	32.6	32.7	31.8	32.6
Frequency				19.0	4.0	23.0	19.0	4.0	23.0
Prop. to total				16.5	3.5	20.0	16.5	3.5	20.0
New									
Ave. mos. since hand over	98.9	84.7	86.7	36.5	33.8	35.2	51.5	68.6	63.2
Frequency	7.0	43.0	50.0	22.0	20.0	42.0	29.0	63.0	92.0
Prop. to total	6.1	37.4	43.5	19.1	17.4	36.5	25.2	54.8	80.0
Total									
Ave. mos. since hand over	98.9	84.7	86.7	34.7	33.5	34.3	44.1	66.4	57.1
Frequency	7.0	43.0	50.0	41.0	24.0	65.0	48.0	67.0	115.0
Prop. to total	6.1	37.4	43.5	35.7	20.9	56.5	41.7	58.3	100.0

Ave. = average, mos. = months, PCWSSP = Punjab Community Water Supply and Sanitation (Sector) Project, PRWSSP = Punjab Rural Water Supply and Sanitation (Sector) Project, prop. = proportion, Rehab. = rehabilitated, WS = water supply, WSS = water supply and sanitation.

Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

[55] An economic life of a subproject is assumed to be 20 years.

1. Technical Assessment of Subprojects

60. **Functional Status.** The technical assessment of the 115 sample subprojects covered (i) functional status,[56] (ii) type of technology and nature of water source, (iii) supplies or connections corresponding to the level of demand, (iv) extent of illegal connections, (v) quality of works, (vi) water sample analysis, and (vii) sanitary inspections. Overall, 80% of the water supply systems were functional, 89% under the PCWSSP and 68% under the PRWSSP. Two thirds of the nonfunctional subprojects belonged to the PRWSSP, reflecting technical difficulties in operations. The nonfunctional status of subprojects was associated with (i) the lack of parts, (ii) frequent breakdowns, (iii) community conflict, (iv) the availability of alternative water sources in the community, (v) dried-up water sources, and (vi) lack of technicians for O&M. In general, the functionality of water supply systems inversely correlated with the availability of alternative water sources, particularly in the southern districts of Punjab. Since an overwhelming majority of the systems used pumps, high electricity charges and erratic power supply harmed their performance. PCWSSP systems performed better than PRWSSP ones because of (i) stable project management, (ii) strong support from the line department, (iii) effective supervision, and (iv) the timely completion of the project activities. However, considerable variation was noted across the study districts. In general, the southern districts performed better than their northern counterparts. These districts had fewer options for water supply and, hence, higher CBO commitment. No significant differences were noted by project type (new construction versus rehabilitated or water supply versus WSS). A higher willingness to pay for water in areas with no alternative water sources served as an incentive to keep these systems functional.

61. **Water Source and Connections.** An overwhelming majority of the water supply and WSS systems relied on groundwater, as 88% of them used tubewells and another 10% groundwater springs, with proportionately more tubewell systems under the PCWSSP. Three fourths of the systems met a benchmark, defined as adequate water supply for all regular users, in the dry season, as did 82% in the wet season. Since access to project water required a 2% cash contribution and the full cost of connecting to the premises from the distribution line, not all households established connections. The findings show that nearly three fifths of households (59% in the PRWSSP and 57% in the PCWSSP) participated in the project-assisted systems, with 89% of those beneficiaries actually receiving water and the rest having a piped connection but unable to receive water for technical or conflict reasons. The lack of alternative drinking water sources meant that the southern districts had higher connection rates than their northern counterparts. Poor households in particular comprised those who could not afford a household connection. They either depended on alternative water sources such as hand pumps or had informal arrangements with households that had water connections. In some communities, limited groundwater discharge capacity imposed constraints on the number of household connections.

62. **Water Availability and Illegal Connections.** The households receiving water received, on average, nearly 5 hours of supply per day from functional systems (4.96 hours under the PRWSSP and 4.85 hours under the PCWSSP), but this varied somewhat across districts. This was largely associated with local CBO decisions, actual requirements, and how effectively the systems were managed. Low pressure in water supply systems induced 18% of households in project areas to use suction machines. These were prevalent in three of the seven study districts: Bahawalpur, Dera Ghazi Khan, and Rahim Yar Khan. Overall, water access from the project systems was fairly high, and 72% of the systems met the benchmark of providing water for all domestic purposes without any complaint. However, one in six subprojects had one or

[56] Functional status refers to whether or not the system is able to provide water to the beneficiaries.

more complaints, in particular muddy water at times. None of the functional subprojects under the study reported illegal connection problems.

63. **Operation and Maintenance Arrangements.** The study examined four facets of subproject O&M: (i) a system of reporting problems, (ii) arrangement for repairs, (iii) the availability of spare parts, and (iv) financial sustainability. The results suggested that 62% of the sample subprojects, and 77% of the functional ones, had a standard system of reporting problems.[57] Slightly less than half (47%) of the subprojects had a benchmark or better system of user payment for water services, but 39% did not have any system.[58] Nearly 58% of the functional subprojects had not encountered any major repair problem; when required, CBOs took care of minor repairs (59%) and major repairs (70%). For functional subprojects, down time was less than 3 days for two thirds of the major repairs. Half of the minor repairs were accomplished within 24 hours, and another one fourth within 2 days. Spare part supply was identified as the weakest link in O&M across all districts. Nearly 83% of the subprojects had either no provision or had exhausted the initial stock of spare parts, and only one in the six subprojects met the benchmark for the availability of spare parts.[59] Slightly more than three fourths (78%) of the sample subprojects had a revenue-collection system, with 94–95% of the community organizations collecting a flat rate. Only 5% of the subprojects, all in the PCWSSP, had adopted a metering system and based revenue collection on actual water consumption. As no systematic way of keeping revenues and expenditure records was found, the financial sustainability of the subprojects could not be determined.

64. **Sanitary Hazards.** Sanitary hazard assessment of subprojects showed that 82% of springs, 53% of shallow tubewells, and 32% of deep tubewells were prone to one or another form of sanitary hazard, with PCWSSP subprojects less prone than PRWSSP ones. The major hazards identified included (i) the presence of solid waste and animal excreta, (ii) no disinfectant used and a concrete floor less than 1 meter wide around the parapet wall, (iii) no chlorination, (iv) wastewater within 10 meters of the well, (v) no fencing for dug wells, (vi) unsanitary valve chambers for community tanks and unsanitary seals for the deep tubewells, (vii) the lack of a ditch to divert surface water, and (viii) an unprotected source and unsanitary inspection cover in the masonry for spring water.

65. **Water Quality.** The chemical tests of water samples from sources and distribution points revealed the chemical quality of water to be good. Only three of the 115 subprojects had high fluoride turbidity. None of the subprojects had arsenic above the tolerance level. However, 45% of the water samples from sources and 72% from distribution networks had bacteriological pollution. While chlorination equipment was provided to all subprojects, fewer than 3% used them. No statistical difference was found in the test results between PRWSSP and PSWSSP subprojects. The bacteriological contamination of water most likely came from human and animal wastewater. Findings from the KAP survey suggested that most of the households boiled water before drinking, and hence no adverse impact on health was observed.

66. **Technical Problems Associated with System Performance.** The top seven problems affecting subproject performance were (i) the lack of alternative pumping machinery, (ii) unfamiliarity with and nonuse of the chlorination system, (iii) broken or leaky valves,

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[57] The benchmark suggested that a caretaker was available, and users were aware of the system of reporting problems through the caretaker but were not always informed about progress in handling the complaint.

[58] The benchmark for a user-payment system was that there was a system of regular payment and most users paid their water dues regularly, or operators collected payment as and when needed for major repairs and rehabilitation.

[59] Standard spare parts were available and parts that were used were replaced.

(iv) broken or leaky pipes, (v) low pressure areas, (vi) the unavailability of components such as appurtenances and joint issues, and (vii) damage to the system from external causes.

67. **Community Self Assessment of Technical Conditions.** Interestingly, local perceptions suggested that the technical condition of the subprojects had deteriorated since handover in half of the cases (52%), while only 5% thought that the condition at the time of survey was better than at the time of handover. The older subprojects under the PRWSSP had proportionately more system problems than the newer ones under the PCWSSP. The study found that awareness of source protection and water quality was significantly higher in project communities than in non-project areas. Similarly, awareness was higher in communities with functional than with nonfunctional subprojects.

68. **Summary.** The technical assessment revealed that several subprojects encountered operational problems, but these were manageable. Most of the functional subprojects are technically sustainable if adequate attention is paid to (i) regularly assessing the water source for water availability and matching demand with supply; (ii) sustainable O&M arrangements, including the timely repair of deteriorating structures and the availability of spare parts, technicians, and back-up tubewell pumps; (iii) improving sanitary conditions; and (iv) financial sustainability.

2. Assessment of Community-Based Organizations

69. **Functional Status.** The findings suggest that 26% of the subprojects had no CBO at the time of the survey, while another 32% had a nominal CBO that was deemed nonfunctional. Only 49 of the 115 subprojects had a partly or fully functional CBO. Two thirds of the functional CBOs had no change in their memberships. Functional CBOs tended to be more closely involved in planning, designing, and operating subprojects. Strong but inclusive leadership, regular meetings, and effective water tariff collection enhanced CBOs' capacity. Nearly three fourths of the functional CBOs considered their involvement in the process adequate, in contrast to the 35% of the nonfunctional CBOs who had no involvement in any form. However, cultural barriers meant women had no direct role in the functioning and decision-making process of the CBOs. Functional CBOs had encountered fewer disputes than nonfunctional ones (30% versus 48%), and proportionately more of the PRWSSP CBOs encountered disputes than their PCWSSP counterparts. The results are not surprising because PRWSSP subprojects went through a learning process and encountered several challenges that were partly addressed in the design and implementation of the PCWSSP. Furthermore, once subprojects were handed over to CBOs, the emphasis on the performance of CBOs received less attention from project management.

70. **CBO Maturity.** The maturity of the functional CBOs was tested using eight groups of parameters,[60] each on a 5-point scale. Results revealed that CBOs performed weakly in six of the eight categories, particularly in linkages and networking, bylaws, and record keeping and documentation. This may be associated with inadequate support given to CBOs during and after the project. Overall, 60% of the CBOs had low maturity, while 36% were rated moderate and 2%

[60] CBO maturity is based on an assessment of (i) clear and transparent bylaws governing different aspects of WSS services; (ii) their ability to develop linkages and networks with other development partners to become broad based and sustainable; (iii) recording and documentation practices demonstrating maturity and transparency; (iv) a system of finance, accounts, and/or assets open to scrutiny to promote the trust and confidence of beneficiaries; (v) inclusive and participatory management; (vi) the improved capacity and skills of workers; (vii) the ease and frequency of community interaction; and (viii) effective leadership qualities and style.

highly mature. The remaining 2% of the CBOs were considered too young for maturity assessment.

71. **Summary.** The results suggest that most CBOs were institutionally weak, which significantly challenges institutional sustainability. Efforts are required to strengthen them through capacity building.

C. Knowledge, Attitude, and Practice Analysis

72. While both projects were designed as integrated WSS and hygiene-promotion interventions, and dedicated community-development and hygiene-promotion staff were hired, the information, education, and communication materials were considered less useful to the communities, and subsequent training was assessed as having little effect. Only 2% of the communities recalled participating in health- and hygiene-related training. Similarly, very few CBOs received support in linking with other service providers and microfinance institutions. The findings of the KAP survey show that knowledge associated with water and sanitation is significantly high, but no marked differences are noted between project and comparison areas, and findings for children are consistent with those of the adults. Interestingly, although only 1% of the respondents received support for toilet construction, almost all households had toilets on their premises. Given the negligible project support for hygiene education, the results are not surprising. Moreover, behavioral change requires a longer time horizon and support mechanisms. This would have required a separate effort independent of water supply facilities. While conceptually it is meaningful, in the context of the two projects the results do not support the claim that sanitation had significant impact on household welfare in the project communities. Hence, the sanitation initiatives undertaken under the projects are not likely to be sustainable.

VI. PERFORMANCE ASSESSMENT

73. **Overall Assessment.** ADB assistance for rural WSS in Punjab can be considered successful but at the low end, based on the ratings of relevant, effective, efficient at the low end, and likely sustainable at the low end. The assessment is based on the findings of this impact evaluation study, the IED-validated PCR for the PRWSSP, which rated the project partly successful, and IED's PCR validation report for the PCWSSP, which rated it successful. In aggregate terms, the projects had positive impact on local communities and people, and project impacts are likely to be sustained with required technical support and the strengthening of the CBOs responsible for managing respective subprojects. Some of the major concerns are: (i) 20% of the subprojects are nonfunctional; (ii) only 43% of CBOs responsible for subprojects are functional; (iii) cost recovery and capital replacement mechanisms are not built-in; (iv) high fuel and electricity costs, and erratic power supply have potential to bring operational subprojects to halt; (v) CBOs capacity remains weak; (vi) government commitment to continued support for subprojects is weakening; (vii) participation of poor remains low due to upfront cash requirements; and (viii) operational link between PHED and TMAs remains very weak.

A. Relevance

74. The evaluation found that the designs of both the PRWSSP and the PCWSSP were relevant to the Government of Pakistan's development strategy and the achievement of the Millennium Development Goals for WSS, as well as to ADB's strategy of supporting projects with potential to satisfy basic human needs and in particular to provide rural people with access to safe water. The community-based approach to rural infrastructure development with wider involvement of local beneficiaries was relevant in project design, during

implementation, and after completion. Piloting WSS interventions in seven pilot districts under the PRWSSP was appropriate, and lessons from its implementation were considered in the design of the PCWSSP. The choice of modality and instrument was reasonably appropriate and had private sector participation through the engagement of contractors.

75. While the objectives of poverty reduction and improving sanitation and/or the environment were conceptually relevant, they proved to be less relevant in the project context because their design did not have adequate institutional support or resource provision. Hygiene promotion and SUPER components had potential to improve project performance, but both components proved less relevant because of the lack of the needed skill mix in the implementing agency and the non-engagement of agencies for these activities. Both projects had limited coordination or complementarity with other development partners, including local NGOs and TMAs and the United Nations Children's Fund. While social mobilization was appropriate for the formation of CBOs and the O&M of the WSS infrastructure, the assumption that the CBOs would be self-sustaining after project completion turned out to be less relevant. Finally, the upfront requirement of 2% cash contribution meant a lower participation rate in the projects.

B. Effectiveness

76. Overall, ADB's assistance in rural water supply was rated effective in achieving its objective. The PCR for the PRWSSP had rated the project as less efficacious due to (i) weak social mobilization, (ii) reduced coverage, (iii) reduced supply of water brought by inadequate water pressure, (iv) the non-provision of filtration and disinfectant facilities, (v) design and implementation problems, (vi) a substantially reduced hygiene education program, and (vii) only partial achievement of institutional strengthening. On the other hand, the IED validation report of the PCR of the PCWSSP noted that the project was highly effective in achieving outputs and outcomes. The project attained its purpose, which was achieving physical targets for (i) forming CBOs and (ii) the construction and rehabilitation of 778 subprojects, more than the target of 750. Stability in project management staff and strong support from the executing agency contributed to project effectiveness. While savings by CBOs was achieved, with a bit of more effort by community development workers and their longer engagement with the project, higher mobilization of saved funds could have been achieved. Additional data collected for the study supports earlier results. In addition, the PCWSSP in particular was effective in introducing water metering in selected communities, which they appreciated. Although water metering was not part of the project design, this initiative was considered favorably in assessing the effectiveness of the PCWSSP.

77. This evaluation found hygiene education and SUPER components to be ineffective. The dissemination of hygiene education materials was quite limited, and some of the educational materials, such as booklets for hanging library, were unsuitable for the beneficiaries as they were text heavy. Similarly, although the PCR stated that the PCWSSP facilitated beneficiaries' access to microfinance, this evaluation did not find any evidence to support this statement. Further, even though the PCWSSP encouraged the formation of a number of female CBOs and the participation of women in CBO meetings, there is no evidence that female members played active roles in decision-making in the design or O&M of WSS infrastructure.

C. Efficiency

78. The assistance to rural WSS in Pakistan is assessed as efficient but at the low end. The PRWSSP was rated as less efficient because of its (i) low EIRR[61] and (ii) delays in start-up and implementation, the recruitment of consultants and contractors, and the handover of completed subprojects to CBOs. The IED validation report of the PCR of the PCWSSP concluded that the project was efficient in terms of using resources and surpassing physical targets. The evaluation considers that the actual project benefits expected in the PCR would be much lower because of (i) less-than-estimated time saved in fetching water, which was monetized; (ii) higher replacement costs associated with vandalized or stolen transformers; (iii) higher fuel costs; (iv) persistently erratic electricity supply; and (v) the resulting reduced hours of operation. Further, even 18 months after project completion, more than 100 of the PCWSSP subprojects had yet to be handed over to CBOs. The delay was largely due to the long time taken to test-run subprojects and/or communities being either unwilling or unprepared to take over O&M responsibilities. This evaluation did not find empirical evidence to support the PCR statement that the projects increased household income, as there was no evidence of significant impact on labor activity or other income opportunities.

D. Sustainability

79. The evaluation findings suggest that assistance to rural WSS is likely to be sustainable but at the low end. The PRWSSP was rated less likely sustainable by the PCR based on the (i) weak performance of operational entities and their ability to recover costs; (ii) lack of proper maintenance policy and procedures; (iii) lack of funds for continued operation, maintenance, and growth requirements; (iv) lack of local government ownership and commitment; and (v) low extent of community participation and beneficiary incentive to maintain project benefits. The lack of government ownership or commitment arose from the vacuum created by the devolution of public health engineering to the TMAs. The validation report of the PCR of the PCWSSP rated the project likely to be sustainable. The report recognized that the maturity of CBOs (footnote 60) responsible for the O&M of infrastructure was weak, there had been no tangible program to enhance the capacity of CBOs, and electricity supply irregularity and fuel costs imposed major challenges to sustainability of schemes.

80. Evaluation findings show improvement in the area of provincial government ownership and commitment. It found that 80% of the subprojects were functional but only 43% of the CBOs were fully or partly functional. The assessment of subprojects revealed that the functional subprojects would be technically sound if adequate attention were paid to (i) regularly assessing the water source for water availability and matching demand with supply; (ii) strong O&M arrangements, including the timely repair of deteriorating structure and the availability of spare parts, technicians, and back-up tubewell pumps; (iii) improving sanitary conditions; and (iv) a viable financial system for O&M. In the absence of data, the financial sustainability of subprojects could not be evaluated. Although recent 3-month revenue and expenditure data indicated that roughly half of the subprojects could meet operational expenditures, the other half fell short, and no definite conclusion can be drawn regarding financial sustainability. The generous contribution from some local elites was noted for a handful of subprojects. There is also no clarity with respect to cost recovery, provision for capital replacement and routine maintenance, and regular budgetary provision for WSS system maintenance. Furthermore, revenues collected from water users were inadequate to support full operation of water supply

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[61] ADB. 2008. *Project Completion Report on the Punjab Community Water Supply and Sanitation Sector Project in Pakistan*. Manila.

systems. The current status of CBOs responsible for the O&M of WSS subprojects suggests that the main foundation of the community-driven initiative is not sustainable unless significant efforts are directed toward enhancing the capacity of both functional and nonfunctional CBOs. In addition, the operational link between PHED and TMAs was found to be very weak, and coordination was lacking between the two and between PHED and other development partners. This would require commitment from all concerned and TMA capacity building in particular.

E. Impact

81. The results of the study show that the projects had clear and large influence on intermediate outcomes (e.g., access to water supply). Their impact on health is consistently revealed in the drudgery or pain from fetching water but only for the lower socioeconomic group. The impact on primary health measures such as diarrhea incidence and severity did not turn out to be significant on average, though cases of significant reduction were found, such as diarrhea incidence for all ages in the middle socioeconomic group. There was a clear increase in school attendance, particularly in high schools, because of the projects. It is noteworthy that the positive impact in this age group was for girls but not for boys. This positive impact on school attendance was found only in the higher socioeconomic groups and, in particular, the middle socioeconomic group. On labor force participation and work hours, the projects had no significant impact on average, though disaggregation found a significant but negative impact in the middle socioeconomic group. Thus, higher school attendance rates came either from withdrawing young persons from the labor force, particularly in the middle socioeconomic group, or from reducing the time spent fetching water. The lack of impact on labor force participation and work hours indicates that the time saved from fetching water documented in the study has not been translated into more income generation, contrary to the expectation of project designers. Thus, the benefits of the projects came in the form of (i) reduction of drudgery, particularly for the lower income group; (ii) increased attendance rates in high school, particularly of girls in the middle socioeconomic group; and (iii) an increase in leisure assumed by the reduction in time spent fetching water that had resulted neither in increased labor force participation nor more hours worked. The survey could not establish significant income impact from projects.

82. Improved drainage in WSS communities and brick-paved community streets facilitated the movement of people in the project communities. Evaluation did not find any evidence of involuntary resettlement in the project areas. The impact of water metering in selected communities is viewed positively as facilitating the more equitable distribution of water.

VII. LESSONS AND RECOMMENDATIONS

A. Lessons

1. Project design

83. **Gender Roles.** Older girls and women benefit significantly from rural WSS projects in terms of reduced drudgery and increased high school attendance. However, not all age group of children are involved in fetching water and, hence, benefits due to improved access to water supply tend to be age specific. The study shows that the older girls tend to benefit most from the time saving resulting from improved access to water because they are able to attend high school, where socially permissible. However, cultural and social barriers may restrict full participation of female household members in key decision-making, including water distribution and O&M.

84. **Synergy between Water Supply and Sanitation.** Investment in improving access to water supply alone is not adequate for delivering health outcomes and impacts, and requires strengthening synergy between water supply and sanitation. This can be achieved only with strong commitment and focus supported by sizable investment in sanitation covering improvements of drainage and street pavements, minimizing sanitation hazards in and around water supply systems, and managing solid waste and waste water at both household and community levels effectively. To facilitate such investment, government policies need to be clear and relevant agencies would have to be actively engaged. Sufficient care should be exercised through coordination with relevant agencies, and ensuring non-duplication of efforts aimed at the common outcome.

85. **Lessons from the Past Operations.** The WSS project design based on (i) lessons drawn from the past ADB operations and by other development partners working in WSS under similar conditions in DMCs; and (ii) conceptual framework demonstrating clear linkages between the planned development interventions and expected economic, environmental, institutional, and social outcomes and impacts on human lives and surrounding environment tend to ensure project completion on time and provide better results. Furthermore, project impacts tend to be context specific and, hence, it is better to avoid generic or vague impact statements in project designs; and to clearly state achievable outcomes and long-term impacts in the project context with given resources. Where the incidence of waterborne illness, such as diarrhea, is already low or there are other contributing factors, water supply related health outcome may not be a realistic objective. Similarly, where unemployment or underemployment is high, WSS intervention may provide more leisure time but not necessarily increase employment or income opportunities.

86. **Relevancy of Project Components.** Project designs should include only directly relevant components and each component must be adequately resourced and implemented by the most appropriate organization(s) and not left to a single agency in accomplishing multiple objectives beyond its capacity. Small add on component(s) that are not directly relevant tend to clutter the project design and create implementation difficulties and consequently projects do not succeed in delivering expected results.

87. **Inclusion of Baseline Data.** Valid individual, household, and community level baseline data are important in setting realistic targets achievable by a project with available resources and within set timeframe. In absence of baseline data, targets tend to be vague and often unattainable. On the other hand, good baseline data steers project implementation towards expected results. Furthermore, it would facilitate monitoring and evaluation of the project implementation and operations.

88. **Role of NGOs and Private Sector.** The formation of CBOs to operate rural WSS does not necessarily guarantee success of subprojects unless the concerned CBOs are capable of managing, operating and maintaining WSS systems in an equitable and sustainable manner. At the same time, the executing and implementing agencies tend not to have required skill mix particularly those relevant to CBO operations. Local NGOs and private sector entities tend to be in a better position to provide such support. Experience shows that they need to be recognized as local development partners and need to be engaged on a medium to long-term rather than short-term basis and hence project designs need to have provisions for such engagement and a sustainable outcome. The engagement of NGOs and private sector entities, however, must be based on performance results.

89. **Inclusion of the Poor.** Community based rural infrastructure do not necessarily guarantee that the poorest and vulnerable segment of the population benefits from the investment due to other constraints. That a little more than half of the households participated in household water supply indicates that cash constraints can limit the participation of the poor in rural infrastructure development such as WSS. The participation rate of poor households in water supply connection was far less than among other households, primarily because they could not afford upfront cash and in-kind contributions in addition to the cost of household connection with the water main. The provision of community standpipes at selected but convenient locations may be more appropriate for these households.

2. Interagency and Donor Coordination and Partnerships

90. ADB needs to work proactively with other development partners in WSS to ensure that expected outcomes and impacts from development interventions are realized with efficient utilization of resources and without duplication of efforts. For example, it would make sense for ADB to partner with health and sanitation related agencies (e.g. UNICEF, Water and Sanitation Program of the World Bank, World Health Organization) to maximize expected health outcomes and impacts from WSS investments. Areas for such coordination and partnerships may include (i) creating demand for sanitation investment; (ii) water quality improvement; (iii) capacity building of institutions at local, district, and provincial levels in both governmental and nongovernmental sectors; (iv) developing incentive structure for institutional performance; and (v) water demand analysis, water resource mapping and water use regulations. While it is recognized that inter-agency coordination and partnerships are difficult to implement for various reasons, such partnerships tend to be successful when the collaboration starts at an early stage. At times, it may require non-conventional approach.

91. **Demand for Sanitation**. Since benefits are not directly visible, demand for investment in sanitation tends to be very low and DMCs are reluctant to borrow funds for sanitation infrastructure. Users tend to be willing to pay for water but not for sanitation. However, sanitation plays a critical role in health outcomes of WSS interventions. Hence, there is a need to create demand for sanitation through new initiatives and partnerships.

92. **Water Quality**. A high level of bacteriological contamination, both at the water source and distribution points; poor utilization of chlorination kits available at the tube well pump stations; and sanitary hazards at the water source, calls for a renewed effort in ensuring availability of safe water to the population. This can be achieved through a functional partnership between CBOs and relevant NGOs and private sector entities with the support from PHED and the Department of Health.

93. **Institutional Capacity**. The implementation capacity of government organizations, local CBOs, NGOs, and private sector in rural WSS tends to be low but it has a strong bearing on the success of the projects. ADB's partnerships with other development partners in DMCs in strengthening capacity of CBOs, NGOs, and private sector has a potential to generate positive spin-off effects which can be valuable in implementing other community-led infrastructure projects, including provision of WSS to the disadvantaged groups, including poor, and marginalized groups.

94. **Incentive Structure.** The institutional incentive structure in rural WSS is weak and tends to be easily influenced by local elites resulting in inefficient water use and inequity in water distribution. However, experience shows that good partnerships between private sector entities, CBOs and implementing agencies can deliver better results as demonstrated by WSS system

operational in Wairo community of Chakwal district. The system requires that the user-charges are proportional to actual use (monitored by water meters) and the CBO has a transparent accounting system.

95. **Water Demand Analysis, Water Resource Mapping and Water use Regulations.** Water demand has been steadily rising, not only for drinking but also for other purposes, while water sources are perceived to be shrinking at the same time. This may lead to conflicts in water use. ADB would benefit from partnering with other development partners in (i) determining demand for water for next 50 years, (ii) mapping water resources available so that future water distributions can be planned, and (iii) water use regulations are put in place so that conflicts in water use are minimized. In the context of the two projects studied, most of the tube wells are constructed along the irrigation canals and are solely dependent on seepage of water from the canals. There is a pressing need to identify alternate water sources as well as means to protect existing water sources.

3. Databases

96. **Baseline Data.** For conducting impact evaluations of development projects or programs, baseline data for individuals, households, and communities are critical. However, data either do not exist or are inadequate for many projects to meet even basic requirements for meaningful project evaluation. This forces the use of a second-best approach, such as creating a synthetic comparison group, as was done for this evaluation. It is important that a project monitoring-and-evaluation design is clearly developed at an early stage in project design and based on a clear conceptual framework demonstrating intermediate outcome and final impact variables. Baseline data collection needs to focus on “with and without” and “before and after” comparisons. Sufficient care must be exercised in identifying valid comparison individuals, households, and communities, and adequate time must be allocated for this purpose. Baseline data are always superior to synthetic comparison groups. Projects with required budgetary provisions and technical support in conducting baseline surveys are likely to have valid data for impact evaluation. Baseline data must correspond to verifiable indicators in the project design and monitoring framework. Such data should be available in user-friendly format so that these could be used in the future project designs and evaluation studies.

97. **Rigorous Impact Evaluation.** RIE provides more reliable quantitative estimates of the impact from the project than does conventional evaluation. An important characteristic of RIE is the identification of a valid counterfactual simulation against which the treated group is compared. Data generated are designed to cover information requirements for rigorous estimation of the impact, using a sample size representative of both the treated and comparison groups. RIE permits disaggregated analysis and assists in explaining more the specific context of impact (qualified impact) in quantitative terms. The PCR, on the other hand, provides at most the direction of impacts and seldom provides precise quantitative estimates of them. If it does provide quantitative estimates of the impact, the basis of the estimate is often unclear. This can be because either the data set used has limited information or it is not representative of the population being studied. More often than not, no valid comparison is established, and estimates are based solely on project beneficiaries. The PCR provides reliable information only on inputs and outputs of the project. RIE techniques permit more disaggregated analysis and unravel any masking effects in the aggregate analysis. A good RIE must be conducted by an independent outfit with active stakeholder participation and reliable data quality so that meaningful conclusions and implications are drawn.

4. Sustaining of Project Benefits

98. **Technical and Community**. To ensure sustainability of project benefits, it is important that, after construction, physical conditions of infrastructure, water pressure, the status of operations, water quality, sanitary hazards, and financial viability are regularly monitored; initially by the implementing agency jointly with concerned CBOs, so that timely corrective measures can be taken and disruptions to water supply avoided. WSS systems perform efficiently if they (i) are financially viable; (ii) are supported by stable O&M arrangements, including the availability of spare parts; (iii) have short breakdown times; and (iv) are efficient and fair in revenue collection (e.g., using metering). Experience shows that CBOs are instrumental to the success of community-led development interventions such as rural WSS and the functional maturity of CBOs (footnote 60) is strongly correlated with the success of the WSS intervention. However, without adequate monitoring, technical support, and capacity building of the CBOs during and after the completion of construction, subprojects run the risk of low performance and even become nonfunctional as was exemplified by 20% of nonfunctional subprojects and 57% of nonfunctional CBOs. With marginal efforts, at least some of these nonfunctional subprojects and CBOs can be turned around and made functional.

99. **Institutional.** There is also a need for a viable and functional mechanism to sustain project benefits which requires a close functional relationships and collaborations at all levels among key stakeholders including PHED, TMAs, and private businesses. A single agency such as PHED trying to do all activities runs a risk of non-cooperation from other agencies, particularly after the project completion and/or external funding ceases. This risk can be mitigated by strengthening not only PHED but also local institutions such as TMAs and relevant private businesses. Local institutions such as TMAs need to develop adequate capacity in terms of human resources development to take over local responsibilities from provincial agencies like PHED. Human resource capacity development would include technical, social, and community interaction skills, as well appropriate incentive structures and resources to keep staff motivation to the desired level.

100. **Financial.** Financial viability is equally important for sustaining benefits from rural infrastructure projects and ideally it is desirable that O&M, routine maintenance and capital replacement costs are met or funded so that the stream of project benefits continues. However, in many instances, user charges barely meet the O&M costs and seldom capital replacement costs. This does not mean that physical infrastructure is allowed to deteriorate in the absence of adequate O&M. A financial back-up mechanism is needed to bridge deficit O&M financing which may come from regular budgetary support or other sources. Institutional structures and incentive mechanisms must be right, along with access to financial means for WSS subprojects to be sustainable.

B. Recommendations

101. **Give prominence to Gender Benefits in Rural WSS Projects.** ADB needs to focus on removing cultural and social barriers to female household members' active participation in rural WSS projects. This can be achieved through advocacy campaigns and working with community leaders. Potential benefits to women and girls, in particular, are tremendous and female members both in terms of reducing drudgery as well as enhancing girls' education; particularly at the high school level. Women are not actively involved in WSS decision making at any stage of project selection, implementation or operations.

102. **Address Wastewater and Solid Waste Management along with Water Supply and Improve Project Design for better Health Outcomes.** ADB should design WSS projects based on strong conceptual linkages between inputs, outputs, outcome, and impacts and take into account context specific development lessons from the operations of ADB and other development partners. The project design should include only directly relevant components of WSS; and demonstrate strong synergy between water supply systems and improvements of drainage and street pavements, minimization of sanitation hazards in and around water supply systems, and solid waste and waste water management at both household and community levels. Project designs should have objectives attainable within a given timeframe and with clearly defined and measurable indicators, duly reflected in the project design and monitoring framework. The project concept should include conduct of a baseline study during the project preparation stage so that the benchmarks are appropriately identified. The Department of Health should be significantly involved in sanitation and hygiene interventions. Microfinance should not be included in WSS projects. Project design should include analysis of the cost-effectiveness of available options instead of cost-benefit analysis, as benefits are difficult to quantify. Consideration should be given to the provision of community taps to benefit poor households unable to achieve household water supply. In addition, to ensure that full O&M costs can be met, project designs need to assess the revenues and expenditures of CBOs to determine their capability to levy and recover costs and provide (i) accounting systems to capture revenue and expenditure, (ii) options for progressive tariff increases combined with complementary budget support, and (iii) visible mitigation such as transition and operational support funds.

103. **Strengthen Interagency and Donor Coordination and Partnerships.** Given that WSS interventions tend to have multiple outcomes and impacts, ADB should actively strengthen existing partnerships and foster new ones with other development partners and DMCs. The area of cooperation, coordination, and partnerships should include maximization of positive health outcomes by (i) creating demand for sanitation investment; (ii) improved delivery of not only clean but safe water; (iii) better result-based institutional incentive structure; and (iv) analysis of water demand and supply and requirements for regulations in water use. Efforts should be made generate positive willingness to pay for safe water and sanitation services, which may initially require advocacy work, and such activities can be effectively taken up by development partners. New investment opportunities must be consistent with ADB strategies and policies and partnerships will strengthen linkages among WSS, hygiene and health issues at both meso and macro levels, thereby contributing to ADB's commitment to deliver health outcomes under Strategy 2020. The government of Punjab and PHED need to map water resources, tapped and not, so that current risks associated with high dependence on water seepage from irrigation canals for most of the tubewell water supply can be managed and a better strategy can be put in place for sustaining the availability of water to most rural residents. To preserve existing tubewell yields, underground water extraction needs to be regulated by the government. The uptake of water metering in rural Punjab is encouraging and should be further strengthened through community development and extension work.

104. **Establish a data bank for baseline studies and databases and promote impact evaluation and sustainability analysis.** All baseline studies and associated databases must be available for ADB project formulation, result monitoring and evaluation. This would require that a centralized user-friendly depository is established and actively managed. The baseline database should be gender disaggregated and include comparable data for both project and counterfactual areas and must be based on valid conceptual framework and causal linkages, including sustainability parameters. This will be of significant value in assessing results of ADB assistance and in conducting impact evaluation studies, including rigorous impact evaluations

more efficiently at a significantly lower cost. Through rigorous impact evaluations, project impact can be quantified and results can be effectively used in resource allocation on the basis what works and what does not. A follow-up of this study in 3–5 years would be useful in determining longer-term impact of ADB investment in rural WSS in Pakistan and determining sustainability. ADB should allocate resources for (i) conducting baseline studies in project designs, and (ii) establishing and actively managing databases and baseline studies. ADB staff should be able to retrieve required database for their project needs, when required.

105. **Ensure Sustainability of Project Benefits.** ADB, should follow-up with the Government of Punjab so that necessary steps are taken to ensure that the rural WSS project benefits are sustained and enhanced. The efforts are required for (i) strengthening functional link between PHED, TMAs, and the private sector for efficient delivery of water supply and allied services; (ii) subprojects becoming financially viable with provisions for routine maintenance, O&M, and capital replacement; (iii) reviving nonfunctional subprojects, if technically and economically feasible; and (iv) assisting nonfunctional or partly functional CBOs to become fully functional through capacity building by engaged competent NGOs and private sector entities. The study calls for a separate mechanism to strengthen subproject CBOs. The role of NGOs and private sector entities should be more than just social mobilization and the conduct of training. They should be able to provide other services, such as water quality monitoring, sanitary inspections, technical analysis, developing financial sustainability, and continued capacity building of CBOs, both during and after the project. To ensure service delivery, these NGOs and private sector entities can be contracted for the duration of the project for defined needs, but their contract should be reviewed annually based on actual performance. Measuring CBO attributes, including their financial sustainability, would improve their effectiveness, efficiency, and sustainability.

ADB LOANS AND TECHNICAL ASSISTANCE TO THE RURAL WATER SUPPLY AND SANITATION SUBSECTOR

Table A1.1: Projects under the Rural Water Supply and Sanitation Subsector
(as of December 2007)

Loan Number	Country	Project Name	Fund Type	Amount ($ million)	Date Approved
0316	MAL	Sabah Water Supply	OCR	15.30	08 Nov 1977
0500	MAL	Rural Water Supply Master Plan	OCR	2.81	19 Dec 1980
0719	NEP	Rural Water Supply Sector	ADF	9.60	11 Dec 1984
0812	PHI	Island Provinces Rural Water Supply Sector	OCR	24.00	04 Dec 1986
1052	PHI	Second Islands Provinces Rural Water Supply	ADF	24.00	20 Nov 1990
1165	NEP	Third Water Supply and Sanitation Sector	ADF	20.00	25 Jun 1992
1349	PAK	Punjab Rural Water Supply and Sanitation (Sector)	ADF	46.00	31 Jan 1995
1352	INO	Rural Water Supply and Sanitation Sector	OCR	85.00	02 Feb 1995
1440	PHI	Rural Water Supply and Sanitation Sector	OCR	18.50	04 Jun 1996
1441	PHI	Rural Water Supply and Sanitation Sector	ADF	18.50	04 Jun 1996
1464	NEP	Fourth Rural Water Supply and Sanitation Sector	ADF	20.00	24 Sep 1996
1755	NEP	Small Towns Water Supply and Sanitation Sector	ADF	35.00	12 Sep 2000
1903	UZB	Western Uzbekistan Rural Water Supply	OCR	38.00	02 May 2002
1950	PAK	Punjab Community Water Supply and Sanitation Sector	ADF	50.00	28 Nov 2002
1993	SRI	Secondary Towns and Rural Community-Based Water Supply and Sanitation	ADF	60.29	16 Jan 2003
2006	KAZ	Rural Area Water Supply and Sanitation Sector	OCR	34.60	29 Sep 2003
2008	NEP	Community-Based Water Supply and Sanitation Sector	ADF	24.00	30 Sep 2003
2208	UZB	Kashkadarya and Navoi Rural Water Supply and Sanitation Sector	ADF	25.00	12 Dec 2005
2265	BAN	Secondary Towns Water Supply and Sanitation Sector	ADF	41.00	16 Oct 2006
2275	SRI	Secondary Towns and Rural Community-Based Water Supply and Sanitation (Supplementary Loan)	OCR	13.50	29 Nov 2006
2276	SRI	Secondary Towns and Rural Community-Based Water Supply and Sanitation (Supplementary Loan)	ADF	46.50	29 Nov 2006
		Total		**651.60**	

ADB = Asian Development Bank, ADF = Asian Development Fund, BAN = Bangladesh, INO = Indonesia, KAZ = Kazakhstan, MAL = Malaysia, NEP = Nepal, OCR = ordinary capital resources, PAK = Pakistan, PHI = Philippines, SRI = Sri Lanka, Supp = supplementary, TA = technical assistance, UZB = Uzbekistan.
Source: Loan and Grant Financial Information Services.

Table A1.2: Technical Assistance Approved under the Rural Water Supply and Sanitation Subsector
(as of December 2007)

Number	Country	Project Name	Type	ADB	JSF	Others	Source	Total	Date Approved
0390	MAL	Rural Water Supply Master Plan	PP	150,000	0	0		150,000	19 Dec 1980
0425	KOR	Small Towns Water Supply Sector	PP	150,000	0	0		150,000	12 Nov 1981
0501	INO	IKK and Small Towns Water Supply Sector	PP	250,000	0	0		250,000	23 Dec 1982
0514	NEP	Rural Water Supply and Sanitation	PP	150,000	0	0		150,000	12 May 1983
0644	NEP	Rural Water Supply Sector	AD	200,000	0	0		200,000	11 Dec 1984
1150	SRI	Rural Water Supply and Sanitation Sector Development Planning	AD	0	600,000	0		600,000	26 Apr 1989
1422	PHI	Training System for Rural Water Supply Personnel	AD	130,000	0	0		130,000	20 Nov 1990
1685	THA	Small Towns Water Supply	PP	0	585,000	0		585,000	02 Apr 1992
1736	PAK	Punjab Rural Water Supply Sector	PP	0	490,000	0		490,000	23 Jul 1992
1818	INO	Rural Water Supply and Sanitation Sector	PP	0	600,000	0		600,000	23 Dec 1992
2089	PHI	Socioeconomic Survey and Evaluation of the Island Provinces Rural Water Supply Sector	AD	100,000	0	0		100,000	12 May 1994
2272	PHI	Small Towns Water Supply and Sanitation Sector	PP	100,000	0	0		100,000	27 Dec 1994
2340	NEP	Fourth Rural Water Supply and Sanitation Sector	PP	0	171,000	0		171,000	01 Jun 1995
2375	VIE	Capacity Building for Provincial Water Supply and Sanitation Planning and Management	AD	0	700,000	0		700,000	17 Aug 1995
2376	VIE	Community Environmental Health Improvements for the Provincial Towns	AD	0	0	500,000	Denmark	500,000	17 Aug 1995

Number	Country	Project Name	Type	ADB	JSF	Others	Source	Total	Date Approved
2609	SRI	Rural Water Supply and Sanitation Sector	PP	0	600,000	0		600,000	17 Jul 1996
3572	KAZ	Rural Water Supply Sector	PP	0	600,000	0		600,000	12 Dec 2000
3688	CAM	Rural Water Supply and Sanitation	PP	0	700,000	0		700,000	23 Jul 2001
3844	NEP	Community-Based Water Supply and Sanitation	PP	0	750,000	0		750,000	13 Mar 2002
3862	PAK	Punjab Community Water Supply and Sanitation	PP	125,000	0	0		125,000	04 May 2002
4063	INO	Community Water Services and Health	PP	1,000,000	0	0		1,000,000	19 Dec 2002
4186	KAZ	Institutional Strengthening for Rural Water Supply and Sanitation Services	AD	0	350,000	0		350,000	29 Sep 2003
4215	PRC	Safe Drinking Water and Sanitation for the Rural Poor	AD	0	0	400,000	PRCF	400,000	12 Nov 2003
4317	INO	Community Water Services and Health Project: Meeting the MDG in the Decentralized Context	PP	150,000	0	0		150,000	27 Feb 2004
4372	UZB	Kashkadarya and Navoi Rural Water Supply	PP		575,000	0		575,000	10 Aug 2004
4654	KAZ	Second Rural Water Supply and Sanitation Sector	PP	0	0	0		0	22 Sep 2005
4807	UZB	Djizzak and Surkhandarya Rural Water Supply and Sanitation Sector	PP	0	400,000	0		400,000	28 Jun 2006
4853	SRI	Small Towns Rural Arid Areas Water and Sanitation	PP	0	750,000	120,000	CFWS	870,000	23 Oct 2006
		Total		**2,505,000**	**7,871,000**	**1,020,000**		**11,396,000**	

AD = advisory, CAM = Cambodia, CFWS = Cooperation Fund for the Water Sector, INO = Indonesia, KAZ = Kazakhstan, KOR = Republic of Korea, MAL = Malaysia, NEP = Nepal, PAK = Pakistan, PHI = Philippines, PP = project preparatory, PRC = People's Republic of China, PRCF = Poverty Reduction Cooperation Fund, SRI = Sri Lanka, THA = Thailand, UZB = Uzbekistan, VIE = Viet Nam.
Source: Loan and Grant Financial Information Services.

LESSONS FROM ADB OPERATIONS IN WATER SUPPLY AND SANITATION SUBSECTOR

1. Some of the key lessons from *Impact Evaluation of Water Supply and Sanitation Projects in Selected Developing Member Countries*[1] are as follows:

(i) Stakeholder roles in planning, implementing, and operating water supply systems have been limited. Perhaps the greatest obstacle to successful participatory development is convincing institutional players that it is indeed possible. Maximizing stakeholder involvement in project decision-making and implementation goes against institutional culture in some developing member countries (DMCs). Success stories from Malaysia and the Philippines show that often just one committed person can lead the way and achieve customer participation. Consistent with Asian Development Bank (ADB) policies that specify the importance of such participation, project designs should make a more concerted effort to realize this objective.

(ii) An effective demand-side management (DSM) program is a simple and cost-effective alternative to supply expansion, particularly in water-scarce areas. DSM succeeds with political support and appropriate campaigns to promote customer awareness of the need for conservation, as observed in Dalian, People's Republic of China. Particularly in water-scarce areas, all ADB-financed medium- to large-scale water supply and sanitation (WSS) projects should include a DSM program of achievable and cost-effective actions, appropriate to the situation, to develop demand-side alternatives to supply-side expansion of system capacity. The program's activities should be prioritized according to their net impact in terms of the amount of water potentially saved and according to their effectiveness in decreasing cost per unit of water saved. Project preparatory technical assistance documents should address the full range of tasks needed to design and implement a DSM program, including (a) technical assessments and recommended actions; (b) financial (for instance, water tariff structure) and economic assessments; (c) customer conservation awareness campaigns; and (d) political support requirements.

(iii) ADB needs to give serious attention of implementing effective programs to promote sanitation, hygiene, and health in its WSS projects. The traditional emphasis on simply providing adequate quantities of good-quality water is not enough to achieve the full benefits of improved individual and community health. Carefully crafted programs to promote sanitation, hygiene, and health, such as the projects in India by the Society for the Promotion of Area Resource Center, are needed for project beneficiaries to become much more aware of the critical links among water, sanitation, hygienic behavior, and health.

(iv) Most WSS projects experience significant delays in implementation. These delays result from institutional, design, policy, and administrative factors that include institutional and capacity constraints commonly encountered in DMCs, overly complex project designs, the proliferation of policy requirements of both external funding agencies and recipients, administrative procedures that are not always well understood, and cumbersome domestic procurement procedures and decision-making processes. Insufficient attention from ADB to project management and monitoring causes slow loan disbursement, adversely affecting project implementation and performance. This can increase project overhead costs and customer dissatisfaction. ADB should consider how best to address this complex but important set of issues. Success stories from projects in India

[1] Available: http://www.adb.org/ Documents/IES/Water/ies_reg_2002_17.pdf

implemented by nongovernment organizations point to innovative approaches, such as turnkey contracts, that ADB may consider as elements in a more streamlined approach to project management for expeditiously implementing WSS projects.

2. Experience from the Greater Mekong Subregion based the valuation study of *Selected Advisory Technical Assistance for Institutional Development and Capacity Building in the Water Supply and Sanitation Sector*[2] revealed that the community health and hygiene programs associated with water supply and sanitation projects are more effective when implemented by a professional organization already engaged in similar activities. Where this arrangement is possible, there is a good chance that activities will continue after the completion of the advisory technical assistance (ADTA). The study highlighted that coordination and timing between ADTA and the associated project is important. ADTA should be implemented only when the new water supply infrastructure provided by the project is in place. If ADTA is related to technical matters, it is more appropriately implemented before or at the beginning of the project so that project implementation may receive the greatest benefit from the ADTA. If ADTA provides support for management and financial matters, coordination with an attached or related project may be less significant.

3. Country studies and those by the Operations Evaluation Department (OED, renamed Independent Evaluation Department in January 2009) provide many useful lessons. Key highlighted lessons from Indonesia include improving operations and maintenance, reducing the amount of unaccounted-for water, taking a cost-effective and environmentally responsible approach, identifying and instituting performance indicators for institutional strengthening, and facilitating the participation of local communities in planning, designing, and implementing projects.[3] Other lessons are caution in adopting standard technical designs to suit local conditions, building an appropriate organizational set up and strengthening effective coordination at all levels of project implementation, recognizing risks and implementing effective risk monitoring and mitigation, emphasizing demand-driven and consumer-oriented approaches, recognizing local knowledge in the design process, and assessing the implementation capacity of the government at all levels and duly adjusting to implementation modalities.[4]

(i) Project evaluation from Nepal indicates that the participation of local communities from the start of rural water supply projects is a basic determinant of success. Using demand management in the design and implementation of such projects can improve both performance and sustainability. Significant advantages will be secured in offering service options that accommodate alternative water consumption levels and in structuring water charges to reflect usage. Synergies will be obtained by coupling these innovations with building users' awareness of the efficient use and conservation of the resource. Where the availability of water poses no problem, rural piped systems should be designed to an appropriate supply capacity with allowance for some portion of household connections beside public standposts (PSPs) and for an adequate average water consumption. If the design capacity is limited and only PSPs are allowed, operational efficiency can be threatened. Many among the intended beneficiaries will not get their share of water. The recovery of costs will be jeopardized as less can be collected from households with higher incomes.[5]

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[2] Available: www.adb.org/Documents/TPARs/REG/tpa_ reg_ 200307.pdf
[3] Available: www.adb.org/Documents/PERs/ie-59.pdf
[4] Available: www.adb.org/Documents/PCRs/INO/pcr_IN26102.pdf
[5] Available: www.adb.org/Documents/PERs/PE494. pdf

(ii) The evaluation of the Rural Water Supply and Sanitation Sector Project in Indonesia[6] provides some technical lessons for designing future projects: (a) Lowland villages need a different approach from highland villages both in technical and social mobilization terms. (b) *Perusahaan daerah air minum* (regional water supply enterprise) schemes need a different approach from community-managed schemes. (c) Systems based on pumps and treatment plants need to be avoided in small communities and, if unavoidable, need extra attention. (d) Special attention needs to be given in the approach to ethnic and cultural differences between areas, as some communities need more focus on health and hygiene education and mobilization. (e) The willingness of the community to utilize public hydrants should be fully researched. (f) House connection systems need to be offered on the principle of recovery of investment and operational costs from beneficiaries. (g) Pour-flush sanitation systems should not be provided without a suitable water supply. (h) School toilets with a connecting water supply have a higher chance of success than public toilets and wash areas.

4. Two rural water supply and sanitation sector projects in the Philippines provide useful lessons for future ADB operations:[7]

(i) The formation of water-user groups and the commitment of their members to pay fees should be a precondition for approving a subproject. Such commitments are necessary for cost recovery, and cost recovery is necessary for good O&M. Failure to enforce such requirements, both by the government and ADB, has contributed to project performance that is less than fully satisfactory.

(ii) The design criteria, once established, should be reflected in subproject selection and appraisal criteria and the appraisal of subprojects. The criterion for the distance from households to point sources is particularly important, as it determines the number of point sources to be constructed, the magnitude of investment needed, travel time for fetching water, and the amount of water consumption. While the present criterion requires a maximum distance of 250 meters, the average actual distance to the point sources constructed was only around 50 meters. This suggests that the point sources may have been provided at closer intervals than intended. The selection of the sites for point sources should attempt to provide them primarily to those households beyond the optimum distance from other point sources with a view to maximizing cost-effectiveness.

(iii) On the planning side, site selection needs to be more demand-driven. The process of consultation with local communities and local government units should be strengthened and structured and should permit the examination of wider options including different types of facilities and options. Nongovernment organizations may have a useful role to play in this connection. The process needs to take into consideration community plans to obtain alternative sources of water to avoid developing several different water facilities in an area. Where available, more springs should be developed, and the watershed areas need to be protected. The extension of spring development to communal standpipes or house connection is something that people appreciate and are ready to pay for and should be promoted wherever practicable. The provision of rainwater collectors, on the other hand, has to be reexamined in view of their frequent

[6] Available: www.adb.org/Documents/PCRs/INO/pcr_IN26102.pdf
[7] Available: www.adb.org/Documents/PERs/PE441.pdf and www.adb.org/Documents/PERs/pe-536.pdf

failure. Unless cost recovery for rainwater collectors can be solved, investment in them is likely to be wasteful.

(iv) Rural water supply facilities (wells, spring development, etc.) benefit a large number of people; save time in fetching water; and promote greater use of water for washing, bathing, and other purposes. Health benefits are the main justification for rural water supply projects, but unless water quality is properly monitored and controlled, the provision of such facilities may not significantly reduce mortality and morbidity. A more thorough investigation and testing of water quality is needed during planning and construction phases even if this involves borehole testing in areas with hydro-geological problems. A number of improvements are needed to maximize project benefits and cost-effectiveness. The national health agency's resources and capacity for bacteriological testing could be strengthened. Alternatively, the feasibility of using local government units or private contractors for such monitoring should be explored.

(v) The responsibilities assigned to central and provincial agencies should be clarified, adequate personnel and other resources should be provided, and a system of accountability must be established. This must entail reeducating beneficiaries on the ownership status of the facilities. Training for testing the quality of water and for organizing water-user groups needs to be strengthened and sustained.

(vi) The capacity of an executing agency to meet the requirements of a sector loan, including the selection and appraisal of subprojects, requires more careful analysis. Where such capacity is considered insufficient or doubtful, assistance to enhance capacity should be provided together with the loan. ADB should supervise the implementation of sector loans more closely. An appropriate procedure needs to be established to ensure that applicable loan covenants for subproject appraisal are complied with.

(vii) Protecting the investment and the quality of water through proper O&M is an urgent requirement. Institutions for collecting water charges need to be established, and they should remain active to ensure cost recovery and proper O&M. Water sources may be contaminated because of poor drainage around point sources and water users' unhygienic habits. More stringent guidelines should be applied in the design, construction, O&M, and training of water users. The alternatives are costly rehabilitation and contaminated water sources.

(viii) There should be adequate community participation at all stages of the project cycle to foster the ownership of project facilities.

(ix) Simple community-level treatment solutions to improve water quality—filtering, chlorinization, the removal of iron, and sterilization—are basic requirements that should be incorporated into rural water supply projects to ensure that the facilities are not abandoned.

5. Forming community water users’ associations and building capacity for improving their skills should precede the actual construction of the water facility. These community organizations responsible for the O&M of projects should first be legally constituted and registered. They require the mandate to regularly collect tariffs, which should be set according to the level of service and to cover expenses for regular and periodic maintenance. This is a prerequisite for the sustainability of the facilities. The handing over of the facility to the community should be supported by a successful test of sustainability for financial and technical aspects for at least 1 year.

GOVERNMENT OF PAKISTAN POLICY ON WATER AND SANITATION

1. The draft National Drinking Water Supply Policy guidelines and recently approved National Sanitation Policy Guidelines (2006) are products of in-depth stakeholder consultation provincially and nationally. Both policies approach water supply and sanitation (WWS) from a human rights perspective. Water for drinking has been categorically given preference over other uses and, once approved, will be basis for resolving many problems related to water rights, especially in arid zones like southern Punjab.

2. While the policy documents mandate the local government institutions in charge of WWS service delivery, these documents fall short of categorically identifying a specific local government entity as the only implementing authority for WWS programs, leaving room for parallel and often vertical government programs. This gray area is likely to create a multiplicity of implementing organizations, leading to overlaps, duplication, competition, and possibly the pursuance of mutually conflicting strategies, to the detriment of the sector. A brief description of key policy provisions of both the policies follows.

A. National Sanitation Policy (2006)

3. The National Sanitation Policy (NSP) provides a broad framework and policy guidelines to federal, provincial (including federally administrated territories), and local governments to enhance and support sanitation coverage through the formulation of their own sanitation strategies, plans, and programs at all levels. The NSP aims to meet the Millennium Development Goals such that the proportion of people without sustainable access to improved sanitation will be reduced by half by the year 2015 and 100% of the population will have improved sanitation by 2025.

4. The primary focus of sanitation, for the purpose of this policy, is the safe disposal of excreta. The use of sanitary latrines and the elimination of open defecation are key objectives, along with the safe disposal of liquid and solid wastes and the promotion of healthy and hygienic practices. The NSP proposes rewards for all "open defecation free" *tehsils* (subdistricts) and towns, for achieving 100% sanitation coverage of *tehsils* and towns, the cleanest *tehsils* and towns, and cleaner industrial estates and clusters.

5. Federal, provincial, and local government agencies will create awareness of sanitary issues through the electronic and print media. All relevant ministries, provincial, and local government departments and/or agencies will develop educational programs and devise plans, programs, and projects to implement NSP provisions. Provincial governments will develop by-laws on sanitation and related issues, and *tehsil* municipal administrations (TMAs) and development authorities will implement the plan. The NSP suggests that sanitation plans be developed for all urban settlements by city governments, development authorities, and TMAs in coordination with all other agencies involved in sanitation. All TMAs and/or city district governments are expected to develop appropriate municipal and industrial wastewater treatment facilities, as well as landfill sites for the disposal of solid wastes.

6. To ensure progress and the effective coordination of policy implementation, a federal NSP implementation committee, comprising representatives of the public and private sector and civil society organizations, will be established. Similarly, provincial governments will establish special cells to coordinate and monitor the implementation of the NSP.

B. The Draft National Drinking Water Supply Policy (2009)[1]

7. The draft National Drinking Water Policy (2009) provides a framework for addressing the key issues and challenges facing Pakistan in the provision of safe drinking water. All aspects related to drinking water are the constitutional responsibility of the provincial governments, and the provision function has been devolved to specially created agencies, TMAs, under the Local Government Ordinance (2001). The policy framework intends to guide and support provincial and district governments in discharging their responsibility in this regard. The policy expects the provincial governments to devise their own strategies, plans, and programs in pursuit of this policy. The goals of the national drinking water policy are to (i) ensure the provision of safe drinking water to the entire population at an affordable cost and in an equitable, efficient, and sustainable manner and (ii) reduce the mortality and morbidity caused by waterborne diseases. The policy promotes a sector-wide approach.

8. The key policy principles that will be pursued in implementing the policy are as follows:

(i) Access to safe drinking water is the basic human right of every citizen, and it is the responsibility of the Government to ensure its provision to all citizens.
(ii) Water allocation for drinking purposes will be given priority over other uses.
(iii) To ensure equitable access, special attention will be given to removing existing disparities in coverage of safe drinking water and for addressing the needs of the poor and the vulnerable.
(iv) Recognizing that women are the main providers of domestic water and maintainers of a hygienic household environment, their participation in the planning, implementation, monitoring, and operation and maintenance (O&M) of water supply systems will be ensured.
(v) Responsibilities and resources will be delegated to local authorities to enable them to discharge their assigned functions with regard to providing safe water in accordance with local bodies' legislation.

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9. The policy has as specific targets

(i) providing safe drinking water to the entire population by 2025;
(ii) the technical specification of schemes to be based on the provision of 45 liters per capita per day for rural households and 120 liters per capita per day for urban households; and
(iii) ensuring the time required for reaching the water source, collecting water, and returning to home is not more than 30 minutes.

10. Key provisions of the policy are (i) increasing access, (ii) protecting and conserving water resources, (iii) water treatment and safety, (iv) appropriate technology and standardization, (v) community participation and empowerment, (vi) public awareness, (vii) capacity development, (viii) public-private partnership, (ix) research and development, and (x) legislation. An outline of each policy provision follows.

1. Increasing Access

(i) New drinking water supply systems will be established, and existing systems will be rehabilitated and upgraded in urban and rural areas, to ensure sustainable access of safe drinking water for the entire population

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[1] Government of Punjab. 2009. National Dinking Water Policy 2009. Islamabad: Ministry of Environment. (Draft, 9 March 2009).

of Pakistan. In this regard, federal and provincial-level governments will provide and mobilize additional financial resources.

(ii) With regard to enhancing access to safe drinking water, priority will be accorded to unserved and underserved areas, both urban and rural, including *katchi abadis* (temporary housing areas) and slums, disadvantaged areas, brackish-water zones, and those areas where there is shortage of sweet water in aquifers.

(iii) All intermittent public water distribution systems will be upgraded in phases through supply-and-demand management and rehabilitation to continuous water supply mode.

(iv) The sustainability of the drinking water supply systems, including the sustainability of the sources and infrastructure, will be promoted.

(v) Adequate provision for the O&M of water supply systems will be ensured when allocating funds for new projects.

(vi) Drinking water availability plans will be formulated for rural and urban areas, especially for mega cities, on the bases of detailed assessments and analyses.

2. Protecting and Conserving Water Resources

(i) Measures will be taken to protect and conserve surface and groundwater resources, as well as coastal waters, in line with the provisions of the National Environment Policy and Pakistan Environmental Protection Act (1997).

(ii) Ambient water-quality standards will be developed and enforced for the classification of water resources on the bases of their uses and detailed assessments. Phased programs for cleaning up and protecting water resources used for drinking will also be implemented in line with the standards.

(iii) Rainwater harvesting at the household and local level will be promoted to augment municipal and groundwater supplies and promote the sustainability of water sources.

(iv) The community management of local water resources and integrated management of water resources will be promoted.

(v) Due consideration will be given to the adverse impacts of climate change in planning and developing drinking water supply systems.

(vi) The abstraction of groundwater for various uses will be regulated.

(vii) Environmental impact assessment will be undertaken for all water sector projects to ensure that they do not adversely impact the environment.

(viii) The recycling and re-use of water will be encouraged.

(ix) Existing water supply systems will be rehabilitated to reduce water loss and wastage.

(x) Water metering will be encouraged to check the indiscriminate use of drinking water.

(xi) Water-saving plumbing equipment and water efficient techniques, devices, and appliances will be promoted.

3. Water Treatment and Safety

(i) Drinking water will be treated to ensure that it complies with the National Drinking Water Quality Standards. To this end, water treatment will be made an integral component of all the drinking water supply systems, both public and private, depending on the quality of source.

(ii) A water quality monitoring and surveillance framework and guidelines will be established to ensure that the quality of all public and private water supplies conforms with the required standards. Water quality laboratories will be established at the provincial, district, and local level, and the quality of drinking water sources and supplies will be regularly monitored.

(iii) Water safety planning will be promoted for urban and rural water supply systems.

(iv) A national action plan for promoting household water treatment options will be developed and implemented.

(v) Federal and provincial-level governments will assign to an appropriate organization the role of the surveillance agency to undertake independent assessment of the quality of water being supplied by the water supply agencies in their jurisdiction. The surveillance agencies will immediately communicate noncompliance with the National Drinking Water Quality Standards to water regulatory agencies, to be designated by the federal and provincial-level governments, for taking appropriate action. The surveillance agencies will prepare annual reports on the state of the drinking water in their jurisdictions. These reports will be consolidated into the national report by the federal surveillance agency.

4. Appropriate Technologies and Standardization

(i) Cost-effective and appropriate technological options to suit local conditions and social and cultural practices will be used. O&M and the availability of spare parts and supplies will be given due consideration in the selection of the technological options to ensure sustainability.

(ii) Federal and provincial-level governments will develop standard operating procedures for the planning, design, construction, monitoring, and O&M of the various categories of water supply schemes. This will ensure adherence to technical standards and specifications, quality construction, and sustainable service.

5. Community Participation and Empowerment

(i) The participation of communities, especially women and children, in the planning, implementation, monitoring, and O&M of water supply systems will be encouraged to promote community ownership and empowerment as well as sustainability.

(ii) Every public sector project will have a special allocation for community mobilization.

(iii) Community mobilization units will be established in water supply institutions.

(iv) Special focus will be placed on gender training programs for the staff of water supply institutions at all levels so that they are able to respond in a sensitive manner to gender-differentiated needs for drinking water.

(v) Special efforts will be made to recruit and induct women in water supply institutions and other relevant agencies to ensure that the needs of women are adequately addressed in the design and O&M of water supply systems.

(vi) The presence of women councilors in all review and decision-making forums regarding drinking water supply in district, *tehsil*, and union councils will be ensured.

6. Public Awareness

(i) Intensive information, education, and communication campaigns will be developed and implemented to promote water safety, water conservation, and hygienic practices. To this end, a national behavioral change communication strategy will be formulated and implemented.
(ii) Hygiene promotion will be made an integral component of all water supply programs.

7. Capacity Development

(i) The roles and responsibilities of various agencies with regard to the water sector at the federal, provincial, and local level will be streamlined to address fragmented and overlapping responsibilities.
(ii) The technical, institutional, and financial capacity of water service providers will be strengthened. The governments concerned will organize training for their staff on planning, implementing, monitoring, and evaluating drinking water supply programs; the effective and efficient O&M of water supply systems; water quality monitoring; community mobilization; hygiene promotion; financial management; budgeting; audit and accounting; contract management; and revenue collection. To this end, governments will establish specialized training academies for WWS.
(iii) The capacity of citizens' community boards and other community organizations will be strengthened for implementing water supply programs and the O&M of water supply systems.
(iv) Performance criteria for service providers will be developed to promote a performance-based approach to service delivery. To this end, systems of performance grants will be established to reward institutions and individuals able to meet performance milestones and achieve specific targets.

8. Public-Private Partnership

11. Private entrepreneurship and public-private partnerships for enhancing access to safe drinking water, the O&M of water supply systems, resource mobilization, and capacity development will be promoted. Civil society organizations will be encouraged to support the government's efforts.

9. Research and Development

12. Special efforts will be undertaken to pilot new approaches and innovative ideas and arrangements for providing drinking water, especially those that help to improve access, quality, efficiency, effectiveness, and sustainability. Where these pilots are successful, they will be widely disseminated and plans will be made to scale-up and replicate them nationally.

10. Legislation

(i) The Pakistan Safe Drinking Water Act will be enacted to ensure compliance with the National Drinking Water Quality Standards and hold the water supply institutions accountable to the general public.
(ii) The National Drinking Water Quality Standards will be enforced throughout the country, and agencies responsible for providing water will ensure that the quality of water supplied by them conforms to these standards.
(iii) The Water Conservation Act and relevant standards and guidelines will be enacted.
(iv) Standards for water-saving plumbing equipment and appliances will be enacted.
(v) Legislation for the regulation of groundwater exploitation will be enacted.

C. Pakistan Environment Policy (2005)

13. The Pakistan National Environment Policy, prepared by the Ministry of Environment, was approved in 2005. Besides setting goals and objectives, the document provides guidelines for various sectors including water supply and management. The document is a set of broad guidelines written with the expectation that provinces will develop their own plans, strategies, and programs to achieve its objectives.

WATER SUPPLY AND SANITATION IN PUNJAB, PAKISTAN

1. Over the past several decades, water supply coverage in Pakistan has improved significantly. Access[1] to safe water in Pakistan is reported to be at 86%, and to adequate sanitation at 57%.[2] The Pakistan Millennium Development Goal Report[3] puts access to safe water at 66% and access to adequate sanitation at 54%. Different data sources give different coverage figures, and the validity of official figures is questionable. There is a general understanding among sector professionals and agencies that actual figure stands lower than the reported figures. Access to safe water, adequate sanitation, and hygiene in Punjab is considered higher than in other provinces.

A. Drinking Water Supply Coverage in Punjab

2. Punjab Province leads the rest of the country, with 98%[4] of the population having access to an improved source of drinking water.[5] Most common improved sources in rural areas include hand and/or motor pumps, while piped water dominates in urban areas. According to the Multiple Indicators Cluster Survey (MICS) 2003–2004, access to improved drinking water sources is consistently high across all districts of Punjab, where the provincial average is 97%.The district of Dera Ghazi Khan, however, has the lowest access to an improved water source, at 77%.[6]

3. Access to an improved source of drinking water within the home is consistently high across both rural and urban jurisdictions, at around 92%.[7] The major contribution to supply within the home comes from private hand and/or motor pumps, which provide improved drinking water supply for 61.5% of the households of Punjab (against 21% for piped water supply). Highly convenient access through hand and/or motor pumps represents a very high investment that communities have made in the self-provision of water, and it is hard to envisage this supply being replaced in the short- to medium-term by government-led interventions.

4. While access to improved water supply is high, the quality of water supplied at the point of consumption is low. Since the bulk of water supplies are self provided, maintaining a quality standard remains a challenge, as common sources of water in Punjab such as shallow tubewells and hand pumps are prone to the risk of bacteriological pollution. If such sources are discounted as unsafe, only 42% of drinking water can be considered safe at source. United Nations Children Fund data from India suggests that 40% of the water that is safe at source becomes contaminated in storage and transport vessels, before it is consumed. In Punjab, this would mean that only 25.5% of the water consumed is bacteriologically safe.[8]

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[1] In Pakistan, water and sanitation access and coverage are taken to be very nearly synonymous, with no separate figures available. Access refers to safe source available within the compound or within a radius of 2 kilometers.
[2] Bureau of Statistics. 2003. *Pakistan Integrated Household Survey 2002/2003.* Islamabad.
[3] Planning Commission, Centre for Research on Poverty Reduction and Income Distribution. 2005. *Pakistan Millennium Development Goal Report*. Islamabad.
[4] Federal Bureau of Statistics. 2007. *Pakistan Social and Livelihood Measurement Survey* 2006/2007. Islamabad.
[5] United Nations International Children's Emergency Fund. *Multiple Indicators Cluster Survey (MICS)* 2003/2004. Punjab. An improved drinking water source refers to piped water supplies, hand and/or motor pumps, and protected wells. As per MICS 2003/2004 assessment, half of the wells are assumed to be closed (i.e., improved) and half open (i.e., unimproved). MICS 2003/2004 found two thirds of other sources to be improved (e.g., standpipes and water sellers), with one third unimproved (e.g., canals, rivers, springs, streams, and ponds).
[6] A follow-up MICS was conducted in fiscal year 2007–2008, but the results have yet to be published.
[7] Government of Punjab. 2004. *Multiple Indicator Cluster Survey 2003/2004*. Punjab.
[8] Ellery, M. 2008. *Punjab—Water Supply & Sanitation Sector Status*. Punjab (A report by the Water and Sanitation Program-South Asia).

B. Hygiene

5. Existing secondary data for Punjab suggests that public understanding of the relationship between poor sanitation and waterborne illness, especially diarrhea, is weak. Limited understanding of the link between health and hygiene is reflected in poor hygiene practices, with only 55% of the population washing their hands adequately after defecation. There is significant variation, as urban residents are twice as likely to wash their hands before eating or after defecating than their rural counterparts.[9] Punjab has a high incidence of child malnutrition,[10] which is partly associated with a high incidence of diarrhea caused primarily by inadequate hygiene and sanitation. Not surprisingly, the under-5 mortality rate in Punjab exceeds the national average.[11]

C. Sanitation Status

6. While some development indicators for Punjab, such as female literacy and education, are well above those of the other provinces, access to latrines presents a slightly different picture. This is particularly pronounced in the rural areas, where only 56% of households have access to a latrine. Not all of these latrines are sanitary,[12] nor are they used by all household members all of the time. This is indicative of a far greater failure to safely contain excreta than the number of latrines suggests. Latrines in urban areas, while present in large numbers, mostly discharge to a septic tank, which are often connected to open drains without proper disposal.

D. Solid Waste Management

7. According to the Pakistan Social and Livelihood Measurement Survey 2005/2006, over 80% the population of Punjab has no access to any form of solid waste management system, 4% engage the private sector, and only 15% have access to a formal municipal system for the collection of solid waste. Most of this solid waste ultimately finds its way to wastewater and drainage systems, choking them and rendering them ineffective. Households do not practice the safe disposal of green waste and recyclable matter at any scale because of inadequate understanding of the segregation, collection, transportation, treatment, safe disposal, and recycling of solid waste.

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[9] Footnote 5, page 40. Washing hands before eating is done by 70% of urban residents and 30% of rural residents, and 80% of urban residents and 45% of rural wash their hands after defecating.

[10] Malnutrition is a consequence of both inadequate food intake and frequent illnesses (especially diarrhea). As per the MICS 2003/2004, 34% of the children in Punjab suffer from malnutrition.

[11] Dehydration caused by diarrhea is a major cause of mortality among children. The MICS 2003/2004 gives the under-5 mortality rate at 112 per 1,000 life births, above the national rate of 103.

[12] Comparing MICS 2003/2004 data with the Pakistan Social and Livelihood Measurement Survey 2004/2005 suggests that as many as 10% of these latrines may be unsanitary.

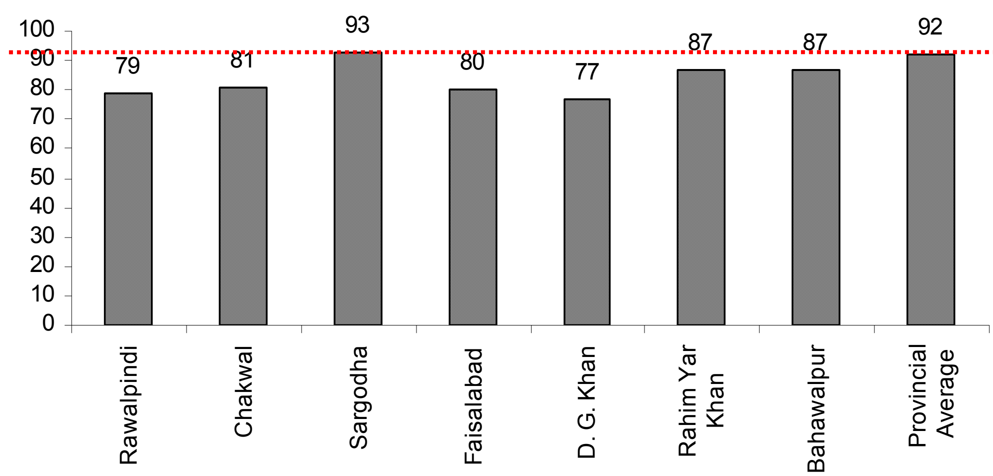
E. Drainage

8. According to the Pakistan Social and Livelihood Measurement Survey 2005/2006, households' access to drainage facilities in Punjab is 65%. Most are uncovered drains, and only 4% are connected to a covered system in rural areas. Effluent from such open drains is a serious threat to the public, particularly children who often play near these drains. Open drains accumulate indiscriminately discarded solid waste, quickly clogging and resulting in putrid overflows of black or grey water in the rainy season.

F. Drinking Water Supply and Sanitation Coverage in the Study Districts

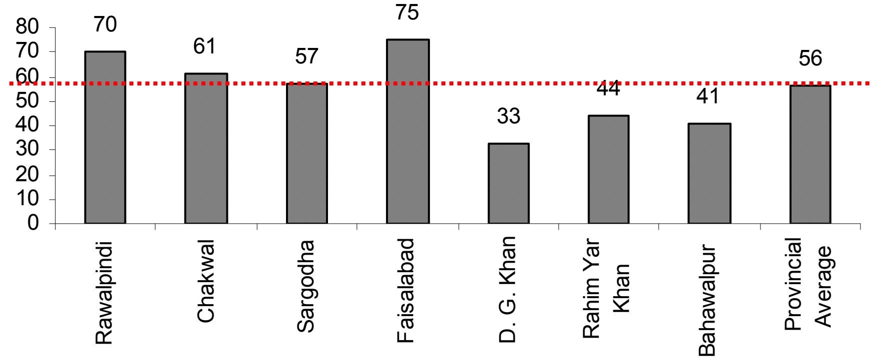
9. The reported access to safe water for the study districts varies significantly, with Sargodha having the highest (93%) and Dera Ghazi Khan the lowest (77%). The provincial average is 92%. As shown in Figure A4.1, all study districts except Sargodha have coverage well below the provincial average. Similarly, Figure A4.2 shows that against the provincial average of 56% for sanitation coverage, Dera Ghazi Khan had the lowest (33%) and Faisalabad the highest (75%). Unlike the case of water supply, where most of the study districts have less coverage than the provincial average, sanitation coverage in four of the seven study districts is above the provincial average. However, the north-south divide is clear, with southern districts showing consistently lower sanitation coverage than the northern districts.

Figure A4.1: Access to Safe Drinking Water
(within dwellings)



Source: Multiple Indicators Cluster Survey 2003–2004.

Figure A4.2: Access to Adequate Sanitation
(%)



Source: Multiple Indicators Cluster Survey 2003–2004.

IMPACT OF WATER SUPPLY AND SANITATION: EVIDENCE FROM THE LITERATURE

A. Impact on Health

1. The literature on the impact of water supply and sanitation (WSS) on health covers different types of WSS interventions on the one hand and varied health outcomes on the other. Water supply interventions include the provision of water supply connections at the community or household level and/or water treatment at the source or at the point of use. Interventions on sanitation and hygiene include (i) the provision of drainage facilities; (ii) intervention on hygiene practices, such as promoting hand washing; or (iii) hygiene education. Interventions are done individually or in combination. Health outcomes affect morbidity of various types, including diarrhea, mortality, and drudgery from fetching water.[1]

2. The modeling of the determinants of health outcomes has two antecedents: socioeconomic and bio-medical. Recognizing this, Mosley and Chen[2] developed a framework that integrates both. Specifically, they argued that the "black box" of socioeconomic determinants of health outcomes can be broken down into (i) environmental and/or personal preventive conditions and measures and (ii) therapeutic measures that are also the primary elements in the bio-medical literature. This perspective led to the identification of personal, household, and community determinants of morbidity and mortality that underlie current morbidity and mortality modeling, including studies on the role of WSS interventions on health outcomes. The economic frameworks that are used to explain health outcomes adds the dimension of motivations for measures adopted and has origins from the human capital (e.g., Becker[3]) and health production function literature.

3. The impact of water connection on health, in particular diarrhea, shows mixed results (footnote 1). While there are no studies that show a statistically significant positive relationship between WSS intervention and health outcomes, some studies show statistically significant negative relationships, while others show insignificant relationships. Using propensity score matching at the household and community level, Jalan and Ravallion[4] estimated the impact of piped water on diarrhea among children 5 years and under in rural India. Their estimates considered both "with and without" and whether piped water is inside or outside the house. Their findings revealed that the prevalence and duration of diarrhea among children under 5 were significantly lower on average for families with piped water than for observationally identical households without piped water. However, the study found that this impact was not statistically significant in poor households below the 4th per capita income quintile, particularly when the mother was poorly educated. The estimate of the impact of piped water inside the house, compared with that of outside the house, showed no significant impact on incidence but was significant for the duration of illness. Again, the negative impact was only for households in the 4th per capital income quintile and down. These results were obtained using household matching. Using village matching, the impact of piped water on diarrhea incidence and duration was no longer significant.

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[1] Independent Evaluation Group. 2008. What Works in Water Supply and Sanitation? *Lessons from Impact Evaluation, IEG World Bank.* Washington, DC; Zwane, A. and M. Kremer. 2007. What Works in Fighting Diarrhea Diseases in Developing Countries? A Critical Review. *World Bank Research Observer*, Vol. 22(1), pages 1–24.

[2] Mosley, H. and L. Chen. 1984. An Analytical Framework for the Study of Child Survival in Developing Countries. *Population and Development Review*, Vol. 10, pages 25–45.

[3] Becker, G. 1981. *A Treatise on the Family*. Cambridge, MA: Harvard University Press. Boston.

[4] Jalan, J. and M. Ravallion. 2003. Does Piped Water Reduce Diarrhea for Children in Rural India? *Journal of Econometrics*, Vol. 112, pages 153–173.

4. Wang, et al.[5] used a case-control method to study the impact of deep-well water through household taps on enteric infectious illness (including acute, watery diarrhea) in rural People's Republic of China. They found that, in the case of acute, watery diarrhea, the incidence in the study region was 38.2% lower than in control regions (187.2 versus 304.9 per 1,000 of population), a difference that was highly significant (P<0.001). Gross, et al.[6] investigated the impact of improving water supply on diarrhea incidence and duration in two urban areas in Brazil and found that the type of water supply statistically affected the incidence but not the duration of diarrhea. It was shown that there was no statistically significant difference in diarrhea between upper and lower income groups. Households with access to public water supply had significantly lower incidence of diarrhea, though duration hardly differed. It was reported that the prevalence of diarrhea was drastically reduced, by 45%, in households with piped water. Fewtrell and Colford[7] conducted a meta-analysis and suggested that water supply interventions in developing countries had no health benefits. Semensa et al. showed that piping water into houses does not affect diarrhea incidence if the water is contaminated and was shown to perform poorly compared with chlorinating water at point of use, even in the absence of piped water to the house.[8]

B. Impact on Education

5. The education impact of WSS, both direct and indirect, has been looked from two perspectives, direct and indirect. The direct impact has been argued in terms of (i) time school-aged children save from fetching water that is expected to enable them to devote more time to education and (ii) convenience, particularly for pubescent girls.[9] The indirect impact is expected from health benefits. Better health is assumed to reduce lost school days. In addition, better health reduces lost work days for working-age people and is expected to increase time for income generation. The expected results are increased income and greater demand for education (footnotes 1 and 9). Less rigorous analysis employing simple comparisons have indicated that proximity to water supply increased school attendance in Tanzania (footnote 9), and providing water and toilet facilities in schools increased school attendance and reduced the dropout rate in India.[10]

6. The evidence from a rigorous impact evaluation of WSS on education is scant. Like the impact on the labor market, it is widely recognized but seldom empirically validated. A study in Bangladesh that focused on education outcomes is an exception.[11] The study examined the impact of (i) drinking water supply in the home, (ii) the availability of water supply in schools, and (iii) the availability of separate toilet facilities in co-educational elementary and secondary

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[5] Wang Zeng-sui, D.S. Shepard, Zhu Yun-Cheng, R.A. Cash, Zhao Ren-jie, Zhu Zhen-xing, and Shen Fu-min. 1989. Reduction of Enteric Infectious Disease in Rural China by Providing Deep-well Tap Water. *Bulletin of the World Health Organization*, Vol. 67(2), pages 171–180.

[6] Gross, R., B. Schell, M.C. Molina, M.A. Leao, and U. Strack. 1989. The Impact of Improvement of Water Supply and Sanitation Facilities on Diarrhea and Intestinal Parasites: A Brazilian Experience with Children in Two Low-Income Urban Communities. *Revista de Saude Publica*, Vol. 23(3), pages 214–220.

[7] Fewtrell, L. and J. Colford. 2004. Water, Sanitation and Hygiene: Intervention and Diarrhea: A Systematic Review and Meta Analysis. *Health Nutrition and Population DP* No. 34960. Washington, DC: World Bank.

[8] Semensa, J., L. Roberts, A. Henderson, J. Bogan and C. Rubin. 1998. Water Distribution and Diarrheal Disease Transmission: A Case Study in Uzbekistan. *American Journal of Tropical Medicine and Hygiene*, 59(6), pages 941–946.

[9] Burrows, G., J. Acton, and T. Maunder. 2004. *Water and Sanitation: The Education Drain*. London: WaterAid. Available: www.wateraid.org/documents/education20report.pdf

[10] Kumar M., M. Snel. 2000. School Sanitation and Hygiene Education in Mysore District. *Waterlines*, Vol. 19(2), pages 16–18.

[11] Khandker, S. 1996. Education Achievements and School Efficiency in Rural Bangladesh. *World Bank Discussion Paper* No. 319. Washington, DC.

schools. Using personal, household, and community characteristics as determinants, it empirically estimated models for school attendance, school attainment, failure rates, and dropout rates for boys and girls 5–20 years old. The results highlighted interesting gender differences. The estimates showed that tubewells as sources of drinking water in the house did not affect school attendance by either boys or girls. It improved the school attainment of boys but not of girls. It affected the failure rate of neither boys nor girls, nor the dropout rate of boys. On the other hand, it lowered the dropout rate for girls. Water supply in school did not affect the schooling attainment of either boys and girls, but it lowered the failure rate of boys. Finally, having separate toilets in co-educational schools did not affect the attainment rate for boys but increased it for girls. It did not affect the failure rate for boys but lowered it for girls. It had no impact on the dropout rate.

C. Impact on Labor Force Participation and Hours Worked

7. The impact of WSS on labor activity has been reported from two angles. Better health was expected to reduce lost work time for those who were sick and for their caregivers. In addition, reduced time required to collect water was expected to result in more time for income generation.[12] Studies on the impact of WSS interventions mostly stop at documenting time saved from fewer sick days and collecting water. There is a dearth of studies that directly estimate whether the time saved from fetching water is actually converted into greater labor force participation rates and/or more labor hours.

8. On studies that document the time saved from fetching water due to improved water supply, a recent review stated that there is "some evidence, though it is weak, regarding time savings from improved water" (footnote 1). For instance, Hutton, et al. (footnote 12), drawing from two reviews[13] of 14 studies, found that the reduction in time spent fetching water ranged from as little as 6 minutes per day for men in Nepal to as much as 7 hours a day in rural communities of Nigeria during the dry season. Their cost-and-benefit analysis of WSS improvements assumed average time savings per day of 0.5 hours (range of 0.25–1.0) per household for water supply outside the home or plot and 1.5 hours (range of 1.0–2.0) for piped water into the house. Similar varied estimates of time spent fetching water in many countries in Sub-Saharan Africa were reported.[14] However, these studies did not extend their analysis to assess whether time saved from fetching water translated to greater labor force participation.

9. Ilahi and Grimand[15] analyzed women's time allocation in rural Pakistan using the 1991 Pakistan Integrated Household Survey and found a significant relationship between the proximity of the water source on women's participation in marketing. In particular, they found a significant negative and quadratic relationship (market time falls with distance but at a decreasing rate) between time for marketing activities and the distance to a community water

[12] Hutton, G., L. Haller, and J. Bartram. 2006. Economic and Health Effects of Increasing Coverage of Low-Cost Water and Sanitation Interventions. *Human Development Report Office Occasional Paper 2006/33*. New York: United Nations Development Programme (UNDP).

[13] Cairncross, S. and V. Valdamanis. 2006. Water Supply, Sanitation and Hygiene Promotion, in (Jamison, D., J. Breman, A. Measham, et al., eds.) *Disease Control Priorities in Developing Countries (*2nd edition), Chapter 41, New York: Oxford University Press; Dutta, S. 2005. *Energy as a Key Variable in Eradicating Extreme Poverty and Hunger: A Gender and Energy Perspective on Empirical Evidence on Millennium Development Goal No. 1*. Department for International Development/ENERGIA project on Gender as a Key Variable in Energy Interventions. London (draft).

[14] Blackden, C. and Q. Wodon (eds.). 2006. Gender, Time Use, and Poverty in Sub-Saharan Africa. *World Bank Working Paper No. 73*.

[15] Ilahi, N. and F. Grimard. 2000. Public Infrastructure and Private Costs: Water Supply and Time Allocation of Women in Rural Pakistan. *Economic Development and Cultural Change*, Vol. 48(4), pages 45–75.

source. In addition, the proximity of the water source was negatively and linearly[16] related to the total (market and non-market) work burden, which they argued was a measure of the women's leisure time. An interesting implication they put forward was that investing in a more accessible water source was like buying leisure for women in rural Pakistan. The authors refrained from claiming impact on household income because, they pointed out, they had not studied market time for men, which could respond to market time for women in the household. In addition, more work participation and work hours may not always mean uniformly higher income across all income classes, particularly in a developing country. Banerjee and Duflo[17] argue that the poor do a lot of jobs or entrepreneurial activities that fill up slack time but lack specialization and skills, so do not necessarily earn more income.

D. Summary

10. The review of existing literature on the impact of WSS interventions on household welfare revealed several gaps. On the aspect of health, the impact on diarrhea is the most commonly studied. Perhaps this is because it is relatively easy to measure and does not require a long response time. But it is also clear that no study has looked at the impact on the drudgery of fetching water. In terms of labor activity, most of the studies stopped at estimating the impact on time saved from fetching water and on the reduction in sick days, while very few explicitly estimated the impact on labor force participation or hours worked. On the impact on education, very few studies have provided direct estimates. As in studies on the impact on labor activity, most merely presumed impacts indirectly using time saved in fetching water and reduction in sick days. Directly measuring the impact of a WSS intervention on these household welfare indicators will, therefore, help fill these gaps in the literature. Disaggregating impact by socioeconomic class is another aspect that will interest policy makers.

[16] Finds the linear fit better compared to a quadratic form for the distance variable.
[17] Banerjee, A. and E. Duflo. 2007. The Economic Lives of the Poor. *Journal of Economic Perspectives*, Vol. 21 (1), pages 141–167.

METHODOLOGY AND STUDY DESIGN

A. Impact Evaluation Methodology

1. Recognition of what constitutes the impact of water supply and sanitation (WSS) projects has gone a long way from an output-based approach, such as on improved access to WSS, to a wide range of development impact even beyond well recognized health impact. White[1] cites the report of the United Nations Millennium Project Task Force on Water and Sanitation, which states, "Better WSS will contribute to reduced income-poverty, improved health and nutrition outcomes, higher educational attainment, and greater gender equity." However, until recently, most research focused on health impacts, in particular on the incidence of diarrhea among children. The review[2] of 100 impact studies of WSS interventions by the World Bank revealed that over 30% used child diarrhea as the impact indicator. Given the wide range of possible WSS impacts, it has been argued that a good impact evaluation should be based on theory and should trace the causal chain from inputs to outcomes (footnote 1).

2. The conceptual framework for this study (Table A6.1) was guided by a literature review of WSS impact evaluation and a program theory that linked goal, resources, activities, output, outcomes, and impact. While a more complex multidimensional framework of analysis was desirable, the study design was bound by time and resource constraints. The study focused on the impact of the WSS intervention in three areas: (i) health, (ii) labor activity, and (iii) education. The health impacts included (i) reduced incidence and intensity of waterborne illness and (ii) reduced drudgery associated with fetching water. The perceived labor activity impacts were (i) labor force participation and (ii) hours worked. Similarly, the education impacts included (i) attendance in primary and secondary schools, (ii) children refusing to go to school for lack of clean drinking water, and (iii) children refusing to go to school for lack of toilet facilities or their poor condition. Various intermediate outcomes were also considered: (i) access to water services, (ii) access to sanitation services, and (iii) improved water and sanitation practices. Project outputs were the provision of (i) water; (ii) sanitation; and (iii) educational material and training on improved health, hygiene, and sanitation practices.

3. These outputs were generated by project activities using project resources. Besides project outputs, also affecting the aforementioned outcomes were personal, household, and community characteristics. Among the personal characteristics are age, sex, and education. The household characteristics included the personal characteristic of the household head, expenditure and wealth indicators, and housing characteristics. Community characteristics include the presence of education, health, water and sanitation facilities, as well as other development indicators. The framework assumed that gender impact is included in all three impact areas.

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[1] Carvalho, S. and H. White. 2004. Theory-based Evaluation: The Case of Social Funds. *American Journal of Evaluation*, Vol. 25(2), pages 141–160.

[2] Independent Evaluation Group. 2008. What Works in Water Supply and Sanitation? *Lessons from Impact Evaluation, IEG World Bank.* Washington; Zwane, A. and M. Kremer. 2007. What Works in Fighting Diarrhea Diseases in Developing Countries? A Critical Review. *World Bank Research Observer*, Vol. 22(1), pages 1–24.

Table A6.1: Logic Model Demonstrating Impact of Water Supply and Sanitation Interventions

Project Inputs/Activities	Outputs	Project Outcomes	Project Impacts
Project Resources **Project Components**	**Water Services** **Sanitation Services** **Training and information on Water and Sanitation Practices**	**Access to Water Services** (i) Access to improved water (ii) Time spent in fetching water **Access to Sanitation Services** Sanitation at home	**Health** (i) Reduce incidence/intensity of waterborne diseases (diarrhea) (ii) Reduced drudgery (pains from fetching water)
Non-project factors **Household and individual characteristics** (i) Age, sex, and education of individual (ii) Age, sex, and education of household head (iii) Expenditure and wealth indicators (iv) Housing characteristics **Community characteristics** (i) Availability of health facilities (ii) Availability of education facilities (iii) Other water and sanitation facilities (iv) General development indicators		**Water Sanitation practices**	**Labor Supply** (i) Labor force participation and employment (ii) Hours worked **Education** (i) School attendance (ii) Children's refusal to go to school due to lack of clean water (iii) Children's refused to go to school due to poor toilet facilities

Note: The causal chain is from left to right.
Source: Based on literature review on water supply and sanitation.

1. Measuring Impact

4. A systematic impact analysis of external support for WSS is a relatively new area, and only limited analysis has been reported. The available evidence is that impact analyses have focused on only selected impact variables such as reduction in the prevalence of diarrhea,[3] improved health and time saving,[4] child health and income (footnote 9), and willingness to pay.[5] However, qualitative and anecdotal impacts are reported on other aspects, including gender.[6,7]

5. Jalan and Ravallion (footnote 3) treated WSS interventions like any other infrastructure and identified two methods. The first method is common in biomedical literature and involves

3 Jalan, J. and M. Ravallion. 2003. Does Piped Water Reduce Diarrhea for Children in Rural India? *Journal of Econometrics*: Vol. 112(1), p. 153–173. New Delhi.
4 Isham, J. and S. Kahkonen. 2002. Institutional Determinants of the Impact of Community-Based Water Services: Evidence from Sri Lanka and India. *Middlebury College Economics Discussion Paper No. 02–20*. Vermont.
5 Gunatilake, H., J-C. Yang, S. Pattanayak and K.A. Choe. 2007. *Good Practices for Estimating Reliable Willingness-to-Pay Values in the Water Supply and Sanitation Sector*. Manila.
6 United Nations. 2005. *A Gender Perspective on Water Resource and Sanitation.* A background paper submitted by the Interagency Task Force on Gender and Water, Commission on Sustainable Development, Twelfth Session 14–30 April 2004, United Nations Department of Economic and Social Affairs. New York.
7 ADB. 2007. Water Supply and Sanitation Issues in Asia. *Asian Water Development Water Outlook 2007 Discussion Paper*. Manila.

comparison of the average outcome indicators under "with and without" intervention scenarios.[8] This method fails, however, to control for individual, household, or community characteristics, which biases comparisons. The second method employs multiple regressions on the impact(s) or outcome(s) of interest, allowing for observable characteristics at the individual, household, or community level as controls. The choice of a specific regression method is guided by the nature of dependent variable.[9,10,11,12]

6. A more recent method of estimating causal effect is matching. The idea is to find for each household with the facility identical household(s) that do not have the facility. The procedure tries to mimic the randomized experiment result by matching through observable characteristics rather than by random assignment. The dimensionality problem means that the most common application uses propensity score matching (PSM) rather than direct matching methods.[13] Pattanayak et al. combined propensity score matching with the difference-in-difference method to evaluate the impact of a WSS project in India.[14] Of course, the gold standard in estimating causal impact is a randomized experiment. Here, both the treatment and comparison units are randomly selected. Randomization is expected to deal with all estimation bias issues.[15] However, this requires adequate measures introduced at project design so that the desired information can be gathered systematically, which often is not the case in

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[8] Esrey, S., J. Potash, L. Roberts, and C. Shiff. 1991. Effects of Improved Water Supply and Sanitation on Ascariasis, Diarrhea, Dracunculiasis, Hookworm Infection, Schistosomiasis, and Trachoma. *Bulletin of the World Health Organization*, Vol. 69(5), pages 609–621; Esrey, S., R. Feachem, and J. Hughes. 1985. Intervention for the Control of Diarrheal Diseases among Young Children: Improving Water Supplies and Excreta Disposal Facilities. *Bulletin of the World Health Organization*, Vol. 63(4), pages 757–772.

[9] Common estimation procedures, such as ordinary least square, probit, logit, tobit, and poisson, provide a consistent estimate for exogenous dependent variable. Instrumental variables estimation methods are used for endogenous dependent variables.

[10] Ilahi, N. and F. Grimard. 2000. Public Infrastructure and Private Costs: Water Supply and Time Allocation of Women in Rural Pakistan. *Economic Development and Cultural Change*, Vol. 48(4), pages 45–75.

[11] Strauss, J. and D. Thomas. 1995. Human Resources: Empirical Modeling of Household and Family Decisions, in (J. Behrman and T. N. Srinivasan [eds.]) *Handbook of Development Economics*, Vol. 3. Amsterdam: North-Holland.

[12] Merrick, T. 1985. The Effect of Piped Water on Early Childhood Mortality in Urban Brazil. *Demography*, Vol. 22(10), pages 1–24.

[13] Rosenbaum and Rubin (1983) showed that, under specific assumptions, the propensity score matching method achieves the properties of direct matching. Jalan and Ravallion (footnote 3) is a prominent example using this methodology in WSS assessment literature. The weakness of the propensity score matching method is that matching can be done only by using observable characteristics. If unobserved characteristics such as motivation, innate ability, attitudes toward risk, or concern for children are important determinants of the outcomes of interest, not controlling for them could likewise bias the results. If one can assume that these characteristics are time-invariant and one has at least two data points for both the treatment and control units, then one can use first-differences in the estimation. This presumably nets out the effect of time-invariant unobservable characteristics.

[14] While propensity score matching is used to match treatment and comparison villages to deal with selection by observed characteristics, difference-in-difference is used to deal with selection by unobserved characteristics. Galiani, Gertler, and Schardgrodsky (Galiani, S., P. Gertler, and E. Schargrodsky. 2005. Water for Life: The Impact of the Privatization of Water Services on Child Mortality. *Journal of Political Economy.* Vol. 113, pages 83–120) have used the difference-in-difference method to study the impact of the privatization of services on mortality in children under age 5.

[15] A recent example of a randomized experiment to assess the impact of a WSS intervention is provided in Kremer et al. (Kremer, M., J. Leino, E. Miguel, and A. Zwane. 2007. Spring Cleaning: A Randomized Evaluation of Source Water Quality Improvement. *Eleventh BREAD Conference on Development Economics*. London: London School of Economics, London). The study uses a randomized experiment to study the impact of water source quality improvement on diarrhea prevalence in rural Kenya. Banerjee and Duflo (Banerjee, A. and E. Duflo. 2008. The Experimental Approach to Development Economics. *National Bureau of Economic Research Working Paper No. 14467*. Cambridge, Massachusetts) provide a recent overview of the strengths and limitations of randomized experiments as a tool for development economic research.

development assistance projects. A summary of different types of impact identified in other studies (i.e., health, labor activity, and education) is presented in Appendix 5.

7. In the absence of household baseline data, the study could not use the difference-in-difference method and had to resort to the single-difference method of estimation. Under this limitation, comparison communities were identified using 1998 district census reports. The assumption was that the project, or "treatment," communities were identical to non-project communities in all respects except for the provision of WSS through ADB-funded projects. The study estimated impact in both ways identified in Jalan and Ravallion (footnote 3): difference in means and regression. The first method computed the simple difference in impacts between the treatment and comparison communities, and the relationship is stated in equation (1).[16, 17]

(1) $$\Delta\bar{y} = \sum_{j=1}^{T} \omega_j (\bar{y}_j^1 - \bar{y}_j^0) = \sum_{j=1}^{T} \omega_i \Delta\bar{y}_j$$

where

$\bar{y}_j^k$	=	Mean values of outcome y for household type k in village j; k=1(treatment), 0(comparison)
$\Delta\bar{y}_j$	=	Difference in mean outcome y for matched treatment and comparison village j
T	=	Number of treatment villages (which is equal to the number of comparison villages)
ω	=	Sampling weights

8. Impact estimation using a regression method is represented by equation (2). The advantage of a regression-based approach over the simple difference mentioned earlier is that the model is able to control for the effects of the other observable variables that affect the outcomes independently of the project interventions.[18] These variables are represented by vector X in equation (2). Under this specification, β_1 provides the estimate of the impact like $\overline{\Delta y}$ in equation (1).[19]

(2) $$y_i = \beta_o + \beta_1 t_i + \boldsymbol{\beta}\mathbf{X}_i + \varepsilon_i$$

where

y = outcome of interest

t = treatment variable (t=1 if treated, 0 otherwise)

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[16] Rubin (Rubin, D. 1973. The Use of Matched Sampling and Regression Adjustment to Remove Bias in Observational Studies. *Biometrics*. Vol. 29, pages 159–183) shows the superiority of estimation using differences in matched samples.

[17] The simple difference-in-means method assumes that the other variables affecting the outcomes of interest are identical for the treatment and comparison households as in a randomized experiment. If these other characteristics are not identical, the difference in means will not correctly estimate the impact but will include the effects of the other characteristics.

[18] Note that this specification captures only the effects of observable characteristics. One common but crude method of capturing the impact of unobservable characteristics, e.g., socio-cultural health and sanitation beliefs and practices, in villages is to use village fixed effects estimation using the equation $y_{ij} = \beta_0 + \beta_1 t_{ij} + \boldsymbol{\beta}\mathbf{X}_{ij} + v_j + \varepsilon_{ij}$ for both linear and similarly non-linear models.

[19] Note that, if these other variables are not included, β_1 is expected to be identical to $\overline{\Delta y}$ or the effective assumption is that the treatment and comparison households are identical on the average except for the project intervention.

X = vector of independent variables
β = coefficients
ε = error terms

9. The specification in (2) assumes continuous dependent variables. Some of the outcomes, however, such as diarrhea incidence or school attendance, are categorical. For these outcome variables, non-linear specifications such as probit or logit are required, and equation (2) can be respecified as equation (3).

(3) $y_i = F(\beta_o + \beta_1 t + \boldsymbol{\beta}\mathbf{X}_i + \varepsilon_i)$

F() is normal in the case of probit and logistic in the case of logit.

10. To implement an estimation based on a regression framework, the methodology followed the estimation of average treatment effects using a control function approach described by Wooldridge.[20] This approach uses the independent variables X as elements of the control function in addition to the treatment variable. The functional form of the control function depends on whether the outcome of interest can be modeled linearly or not. For linear models, the elements of the control function are the independent variables and the interaction between the treatment variable and the demeaned values[21] of the independent variables. For non-linear models, such as probit or logit, the propensity score approach is recommended.[22] In this method, the propensity score, which gives the likelihood of having the treatment given the values of independent variables, and the product of the treatment variable and the demeaned values of the estimated propensity score are the elements of the control function. Equations (4) and (5) estimate linear and nonlinear models, respectively. For linear models, the estimate of the average treatment effect[23] is given directly by β_1 and for nonlinear models this is given by the difference in expected value of y given X for the treatment and the comparison groups, i.e., the marginal effects of the treatment variable.[24]

(4) $y_i = \beta_0 + \beta_1 t_i + \boldsymbol{\beta}_2\mathbf{X} + \boldsymbol{\beta}_3 t_i(\mathbf{X} - \overline{\mathbf{X}}) + \varepsilon_i$.

where
y = outcome of interest
t = treatment variable (t = 1 if treated, 0 otherwise)
X = vector of independent variables
β = coefficients
ε = error terms

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[20] Wooldridge, J.M. 2002. *Econometric Analysis of Cross Section and Panel Data.* Cambridge, Massachusetts: Massachusetts Institute of Technology Press.

[21] For any variable X, the demeaned values are $(x - \overline{x})$ where $\overline{x}$ is the mean of X.

[22] Wooldridge (footnote 20) argues that, for continuous variables, neither the linear nor the propensity score method dominates the other. Therefore, one can use both methods for continuous dependent variables. However, to arrive at the estimation form for linear models (4), the linearity of E(y|X) is assumed. As this is untenable for nonlinear models, the propensity score method is recommended.

[23] The average treatment effect is the average effect of a binary or dichotomous explanatory variable. Here, the treatment is having or not having the project.

[24] Under specific assumptions, the estimate of the average treatment effect can be derived from the generic expression $E(y \mid \mathbf{X}, t = 1) - E(y \mid \mathbf{X}, t = 0)$. Note that no functional assumption is made here, so this is valid for any consistent estimate of y, linear or non-linear (footnote 20).

(5) $y_i = F[\beta_o + \beta_1 t_i + \beta_2 P(t_i \mid \mathbf{X}) + \beta_3 t_i (P(t \mid \mathbf{X}) - \overline{P(t \mid \mathbf{X})}) + \varepsilon_i]$
where
P(t|**X**) = Propensity score

11. Several impact variables were considered in the study. As stated in Table A6.1, the incidence and intensity of diarrhea and back pain from fetching water represented health impacts. Both sets of variables were binary (0, 1). Education impacts were represented by four variables: (i) attendance at primary school, (ii) attendance at secondary school, (iii) households with children refusing to go to school for lack safe drinking water, and (iv) children refusing to go to school for lack of proper toilet facilities. All education impact variables were binary as well. Similarly, labor activity impact variables included labor force participation (binary) and average hours worked (continuous). The basic treatment variable was the presence or absence of the subproject. The presence of the subproject refers to what is known in the literature as the *intension-to-treat* effect.[25]

12. The other independent variables used in the control functions were those commonly used in the literature (e.g., footnote 3 and Mosley and Chen[26]). These included household, community, and individual characteristics in cases where the individual is the unit of analysis (e.g., diarrhea incidence and labor supply variables). The household characteristics examined were the characteristics of the household head (e.g., age, sex, education, occupation, and sector of work), household expenditures, housing characteristics, and household assets. Community characteristics included location dummies representing district, school, and health facilities; other development indicators (e.g., transport facilities); demographic characteristics (e.g., population and number of households); and main sources of livelihood. Age, sex, and education were individual characteristics.

2. Identification of Counterfactuals

13. The importance of using the characteristics of the village prior to the intervention, as opposed to current conditions, as the basis for matching was emphasized in Pattanayak et al. (2007).[27] Also, Jalan and Ravallion (footnote 3) argued for the superiority of a matched sample compared to an unmatched sample in the estimation of the impact of interventions. To implement the treatment-comparison group design, the study team prepared a list of matching comparison villages against the list of treatment (project) villages, using the only available village data source at the time of project intervention, the district census reports 1998.[28] The list of matched villages was shared with development practitioners knowledgeable about the area. Four key parameters were used for matching: (i) total village area, (ii) number of

[25] One can use the households with piped water as the treatment to generate the effect of treatment on the treated. However, this is clearly an endogenous treatment variable. Estimation for endogenous treatment would require instrumental variable estimation for linear models, instrumental variable probit for discrete outcomes (Woolridge, J.M. 2000. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, Massachusetts: Massachusetts Institute of Technology Press.); and instrumental variable–generalized method of moments approach for count models (Cameron, A. and P. Trivedi. 2005. *Microeconometrics: Methods and Applications*. New York: Cambridge University Press). The presence of the subproject in the village is a good instrument. It satisfies the conditions for an instrument by being (i) directly related to the treatment and (ii) not related to the error term of the primary equation.

[26] Mosley, H. and L. Chen. 1984. An Analytical Framework for the Study of Child Survival in Developing Countries. *Population and Development Review*, Vol. 10, pages 25–45.

[27] Pattanayak, S.K., C. Poulos, K.M. Wendland, S.R. Patil, J. Yang, R.K. Kwok, and C.G. Gorey. 2007. Informing the Water and Sanitation Sector Policy: Case Study of an Impact Evaluation Study of Water, Sanitation, and Hygiene Interventions in Maharastra, India*. Research Triangle Institute Working Paper 06_04*. North Carolina.

[28] At the community level, household lists were not available at the time of the study.

households with potable water, (iii) average household size, and (iv) literacy rate. The absence of potable water was a major consideration in the selection of the project villages for WSS intervention. The paucity of village data was the main reason for this minimalist method of matching villages.[29] In each of the treatment and comparison villages, an equal number of sample households were randomly selected. The randomization of household selection in villages was expected to normalize the distribution of outcomes at this level. The matching was therefore done at the village rather than at the household level, as is usually done in studies that use propensity score matching.[30]

3. Sampling Procedure

14. The study area comprised 7 of the 30 districts covered by the Punjab Rural Water Supply and Sanitation Project (PRWSSP) and the Punjab Community Water Supply and Sanitation Project (PCWSSP),[31] randomly selected. These seven districts accounted for 54% of study-eligible ADB-supported WSS subprojects. Four of the seven districts represent both the PRWSSP and the PCWSSP, and the remaining three were PCWSSP-only districts. Taking into account resource constraints and following Barlett et al.,[32] 115 subprojects were identified using stratified random sampling methods, accounting for due representation of type of subprojects (PRWSSP versus PCWSSP, new construction versus rehabilitation, and WS versus WSS).[33] All sample subprojects had been handed over to community organizations for operation and maintenance (O&M) by the Public Health Engineering Department (PHED). The study team prepared a list of the names of the subprojects and corresponding number of households connected. A total of 1,296 treatment households and 1,301 comparison households were in the household survey.[34] The number of sample households for each subproject was in proportion to its relative share in the total number of the households (Table A6.2).

Table A6.2: Sampling Distribution

District	Total No. of Subprojects			No of Sample Subprojects			No. of Sample Households			Comparison Households	Grand Total
	PRWSSP	PCWSSP	Total	PRWSSP	PCWSSP	Total	PRWSSP	PCWSSP	Total		
Rawalpindi	47	34	81	12	6	18	118	67	185	185	370
Chakwal	47	43	90	12	9	21	173	123	296	296	592
Bahwalpur	54	34	88	13	8	21	124	79	203	203	406
RY Khan	54	38	92	13	8	21	102	56	158	158	316
Sargodha		53	53	0	9	9	0	95	95	95	190
Fasialabad		40	40	0	7	7	0	76	76	76	152
DG Khan		82	82	0	18	18	0	288	288	288	576
Total	**202**	**324**	**526**	**50**	**65**	**115**	**517**	**784**	**1,301**	**1,301**	**2,602**

No. = number, PCWSSP = Punjab Community Water Supply and Sanitation Project, PRWSSP = Punjab Rural Water Supply and Sanitation Sector Project.
Note: Each subproject represents one community.
Source: PRWSSP and PCWSSP project databases and information provided by the project staff in August 2008.

[29] Had more village data been available, propensity scores based on project participation, using the variables, could have been computed and used to match villages.
[30] This is a slightly modified version of the design presented in the approach paper. The approach paper mentioned propensity score matching of households, which could not be implemented, however, for lack of large survey data in the study area that could be used to provide statistically matched households.
[31] The PRWSSP and the PCWSSP constructed 335 WWS subprojects and rehabilitated 778 WSS subprojects. The 778 PCWSSP subprojects covered 30 of 35 districts of Punjab but the distribution across districts is uneven. For example, 10 of 30 districts have fewer than 10 subprojects, and another four have between 11 and 14 subprojects. Seven districts were randomly selected from the list of remaining 16 districts.
[32] Barlett, H., J.W. Kotrlik, and C.C. Higgins. 2001. Organizational Research: Determining Appropriate Sample Size in Survey Research. *Information Technology, Learning and Performance Journal, Vol. 19(1):43–50*.
[33] There were only 16 sanitation-only subprojects, so they were excluded from the analysis.
[34] The sample included an additional 20% to accommodate non-responding households or incomplete surveys.

15. All 115 sample subprojects were subjected to technical assessment, and the study team held discussions with the community-based organization (CBO) and gathered information for their capacity assessment. For qualitative information and triangulation purposes, the team conducted 10 key informant interviews in each of the seven districts. The key informants included school teachers, health workers, local community and religious leaders, *tehsil* municipal administration (TMA) staff, and PHED staff. To assess the impact of health and hygiene awareness campaigns, a knowledge, attitude, and practice (KAP) survey was conducted with 50 adults (25 male and 25 female) and 50 children (25 girls and 25 boys) in each district. The survey covered an equal number of participants from the comparison villages.

4. Data Collection

16. The study adopted a mixed-method approach to data collection,[35] which involved (i) household surveys, (ii) KAP surveys, (iii) focus group discussions, and (iv) key informant interviews. The study team developed data collection instruments and guidelines, and these were and pretested and modified based on the feedback before conducting interviews (Supplementary Appendix A). The household questionnaire had 10 sections: (i) household identifiers; (ii) personal characteristics of individual household members or the household roster; (iii) waterborne disease–related and other morbidity information; (iv) education; (v) employment and livelihood; (vi) water sources; (vii) sanitation facilities and practices; (viii) health education, community participation, and institutions; (ix) housing characteristics; and (x) household assets and expenditures. The community questionnaire had five sections: (i) physical characteristics; (ii) demographic characteristics; (iii) basic services and institutions such as education, health, water, garbage or waste disposal, and transportation; (iv) other water and sanitation projects; and (v) electricity service availability. The technical and CBO capacity assessment instrument had 10 modules: (i) CBO profile, (ii) training, (iii) institutional maturity index, (iv) community perception about access and quality of water, (v) O&M, (vi) quality of work, (vii) technical assessment, (viii) water quality, (ix) sanitary inspection, and (x) laboratory test report. The enumerators recorded responses from the interviewees on the structured household and KAP questionnaires based on respondents' recall. The study made use of relevant data from PHED. Data collection was undertaken by two local firms. A detailed methodology for the technical assessment of subprojects and CBO capacity assessment is outlined in this Appendix.

5. Limitations and Opportunities

17. In the absence of verifiable household or individual baseline data, the proposed rigorous impact evaluation adopted a single-difference method of analysis for evaluating the impact of the two sector projects. The data generated by the study will serve as a foundation for conducting a more robustly rigorous impact evaluation using panel data and applying double-difference method in 3–5 years' time. A second limitation of the study was that the list of comparison communities did not exist and had to be prepared based on the 1998 district census reports. The study made provision for an additional 20% household coverage in the household sample survey to accommodate non-response and incomplete questionnaires. The Independent Evaluation Department made efforts to develop partnership with the Punjab Bureau of Statistics

[35] Bamberger, et al. (Bamberger, M., J. Rugh, and L. Mabry. 2006. *Mixed-Method Evaluation. Real World Evaluation: Working Under Budget, Time, Data and Political Constraints*. Chapter 13. California: Sage Publications) argue that mixed-method evaluation combines the detailed insights and holistic understanding obtained from qualitative research with the ability to generalize to a wider population offered by quantitative data collection. Thus, it allows for a more comprehensive analysis. Mixed-method designs can be employed to strengthen validity, fine-tune sampling and instrumentation, extend the coverage of findings, conduct multilevel analysis, and generate new and diverse insights.

and university research centers for conducting the study, but it did not materialize in the timeframe for the study because of researchers' prior commitments. Instead, the study relied on local expertise and engaged two separate firms for fieldwork.

B. Subproject Sustainability Evaluation Methodology

18. A discussion of the methodology employed in assessing the sustainability of subprojects is in the following paragraphs.

1. Technical Assessment

19. The technical assessment of subprojects covered (i) functional status, (ii) type of technology and nature of water source, (iii) supplies or connections corresponding to the level of demand, (iv) extent of illegal connections, (v) quality of works, (vi) water sample analysis, and (vii) sanitary inspections. The rationale associated with these parameters is discussed next.

2. Functional Status

20. A subproject was considered functional if the community organization had operated regularly and maintained it in good repair for the previous 4 months. If a subproject had not been operated over the previous 4 months and the community organization had no plans for operating it in the future, the subproject was deemed nonfunctional. Local knowledge dictated that a 4-month cutoff was appropriate to determine functional status. A functional subproject has a greater likelihood to succeed than a nonfunctional one, and the longer a subproject remains nonoperational, the less likely it will be revived and become sustainable.

3. Type of Technology and Water Source

21. The type of technology and nature of water source often dictate the long-term sustainability of subprojects. Gravity-based subprojects tend to incur much lower O&M costs than mechanized ones. Complex subprojects demand more caretaking and maintenance costs and are relatively less likely to be sustainable, particularly in rural areas that lack technical expertise. On the other hand, spring and shallow well–based schemes are prone to sanitary hazards unless source protection measures and a system of surveillance and water quality testing are in place to ensure the delivery of safe water throughout the year. The study collected data on the types of technology, sources of water, sanitary hazards of the source and water supply system to help establish the likelihood of long-term sustainability.

22. The likelihood of sustainability is greater in areas facing water scarcity because consumers are more willing to pay a fair price for drinking water than people with alternative sources providing comparable water quality and reliability. The study sought information on the availability of alternative source(s) of drinking water, their reliability, and public perceptions about water quality to ascertain the long-term sustainability of subprojects.

4. Response to Community Demand

23. The total number of households connected to the water supply or sanitation system, against the total number of households in the community, was taken as an indicator to help determine the degree to which a subproject was judiciously selected, based on community's felt need following an expression of demand from its vast majority. This also indicates the degree to which the community values their improved water supply system and whether they prefer safe

water or free water,[36] indicating the effectiveness of community mobilization and demand for safe drinking water.

5. Illegal Connections and Leakages

24. Illegal connections reduce the sustainability of subprojects. Illegal connections and leakage may take one of the two forms: diversions in connections and use of suction pumps. The study sought information on the number of illegal connections in communities in proportion to the number of connections and number of households using suction pumps. The information highlights community organizations' commitment to sustainable O&M.

6. Quality of Works

25. High quality of works likely translates into a more sustainable subproject if the system is operated and maintained satisfactorily. Project works include those at source, storage, transmission, pumps, and distribution system. An assessment of the quality of works was essential to identify works more prone to problems, determine if they were the result of poor maintenance or otherwise, and the impact on the quality of service and the system's sustainability. The indicators used for assessing the quality of works at the source (e.g., wells, tubewells, infiltration galleries, river intakes, etc.) included (i) structural damage; (ii) sources prone to or actually flooded or submerged; (iii) yield drops at certain times of the year; (iv) current disputes for any reasons; and (v) treatment such as the provision of chlorination and other disinfectants. The appropriateness of storage points was assessed by inspecting physical damage, the appropriateness of locations, and sanitary conditions there. Similarly, transmission systems were inspected for damage from external causes; joint or appurtenance issues; and high- or low-pressure problems resulting in frequent bursts, leaks, or low pressure areas.

26. The study assessed pumping systems on the adequacy of pumping capacity, including tank-filling duration; unserved or low-pressure areas in the case of direct pumping; and the availability and functionality of devices to protect against voltage fluctuations and electrical surges. The study recorded general safety against vandalism and theft. A discharge meter allows a pump operator to maintain a record of water supplied. This time series data serves as a good planning tool for assessing future expenditure and revenue requirements. Similarly, the availability of a distribution pipe network layout plan and strata chart[37] at the tubewell serves as a readily available tool for system monitoring and future planning for network extension or tubewell deepening. The study therefore noted the presence or otherwise of a distribution pipe layout plan and a strata chart. If everything at a pumping station was satisfactory but the operator did not know the correct pump start-up and closing procedure, it is very likely that the pump will develop serious problems. The study asked the operator to describe and demonstrate the correct start-up and closing procedure. Similarly, the study noted the availability of backup machinery to ascertain if the system could continue to deliver safe water during a prolonged breakdown, which otherwise may diminish consumers' satisfaction and willingness to pay and, eventually, the sustainability of the scheme. Other areas of inquiry were physical damage to the pump during extraction, installation, or transportation and the availability of necessary tools and arrangements (e.g., wrench, iron beam arrangements, etc.) for extracting the pump for repairs and reinstallation.

[36] Assuming the water is affordable.
[37] A log of different subsurface layers through which the tubewell has been installed.

27. The study assessed the distribution pipe network for areas of low pressure and whether pipelines or valves were often broken or leaking. It observed if meters for measuring water discharge existed and were functional. Lastly, the survey sought community views on whether the distribution system is operated to provide water fairly.

28. To ascertain if the quality of different works has changed over time, for good or bad, the study asked if the scheme was, at the time of handing over, (i) better than it is today, (ii) worse than it is today, or (iii) the same. The study further explored if the subproject was properly tested after completion and before being handed over to the community organization. The results helped allow commentary on the state of the assets at the start of community management. This information provided a context for the proportion of nonfunctional or partly functional schemes and an assessment of subprojects' longer-term sustainability.

7. Water Sampling and Quality Analysis

29. Water quality tests determine if water has been contaminated at a particular point, which is likely to highlight failure in maintenance and caretaking and help identify remedial measures. Water samples were drawn at source and at the point of distribution, and tests were performed for key parameters defined by the World Health Organization: (i) microbiological quality (coliforms count) and associated parameters such as disinfectant residuals, P^H, or turbidity; (ii) parameters associated with the rejection of water (turbidity, taste, colour, and odor); and (iii) chemicals known as health risks, particularly fluoride, arsenic, and nitrate.

8. Sanitary Inspection[38]

30. A comprehensive sanitary inspection of a water supply scheme identifies potential hazards, while laboratory testing indicates the presence and intensity of contamination. The World Health Organization[39] has developed a number of typical sample checklists for conducting sanitary inspections, which it tested with minor alterations and adjustments. These forms or checklists contain a series of yes-no questions, where "yes" indicates a hazard or a problem. Ten questions are posed, for a score of 0 to 10. To ascertain if water quality is regularly tested, the study asked for the results of previous tests and any source-protection measures instituted by the community to reduce sanitary risks.

9. Community Organizations' Capacity Assessment

31. Active community participation at all stages of the project was recognized as a unique feature of the project design in both the PRWSSP and the PCWSSP. This is consistent with the notion that strong community organizations serve as basic building blocks for effective, efficient, and sustainable community-led rural infrastructure development, including rural WSS subprojects. In the absence of well-led, broadly representative, and inclusive community organizations having well-established systems and procedures, the system of infrastructure caretaking remains informal, with transactions that often lack transparency and documentation, losing consumers trust in community organization management. Revenue collection is untimely or nonexistent, and most beneficiaries, unhappy with the level of service, resort to alternatives sources and gradually become unwilling to pay for the service. Eventually, the whole system

[38] A sanitary inspection is an on-site inspection and evaluation by qualified individuals of all devices and practices in the water-supply system that pose an actual or potential danger to the health and well-being of consumers. It is a fact-finding activity that identifies system deficiencies—not only the sources of contamination but also inadequacies and lack of integrity in the system that could lead to contamination.

[39] World Health Organization. 1993. *Guidelines for Drinking-water Quality*. Vol. 1, Recommendations. Geneva.

becomes prone to failure. Leadership plays a critical make-or-break role, as does the community interaction and its ability to resolve conflicts and disputes.

32. The attributes of an effective and strong community organization include (i) clear and transparent bylaws governing WSS services; (ii) the ability to develop linkages and networks with other development partners to become broad based and sustainable; (iii) record and documentation practices demonstrating organizational maturity and transparency; (iv) a system of finance, accounts, and assets open to scrutiny to promote trust and confidence among beneficiaries; (v) inclusive and participatory management; (vi) improved worker capacity and skills; (vii) ease and frequency of community interaction; and (viii) leadership with effective qualities and style. These eight broad attributes were assessed using 131 objectively verifiable indicators. The matrix of indicators was developed such that under each category and subcategory the researcher had to select one indicator out of a list of five mutually exclusive responses. Since the selection of an indicator was not meant to be subjective, means of verifying objective indicators were also identified. Both objective, verifiable indicators and means of verification were thoroughly discussed and refined in a number of discussions with stakeholders. Each community organization was rated as mature, developing, or immature according to its aggregate score.

33. A strong community organization is essential for a well-operated water supply scheme. It can be only partly effective unless its office holders and employees are fully capable to discharge their assigned functions. In principle, an investment in building the capacity of a community organization must be proportional to the scheme cost. Hence, the greater the complexity and cost of the scheme, the greater the effort that must be invested in strengthening community organizations and ensuring the sustainability of subprojects. The study noted that the Public Health Engineering Department provided training in (i) financial management for CBOs, (ii) health and hygiene awareness, (iii) strategies for toilet construction, (iv) the installation of water meters, and (v) linking CBOs with microfinance institutions. Using quantified participatory assessment and recall, the study tried to find the relevance and utility of this training.

34. The maturity and capacity of a community organization is liable to change over time. In the absence of ongoing capacity building, mentoring, and follow-up support, the maturity and capacity of a community organization deteriorates. The pace of deterioration is proportional to the rate of member and/or management turnover. It was therefore desirable under this study to probe if a community organization's management (i) has remained exactly the same as at the start, (ii) is broadly the same with some or many new members, or (iii) entirely new in its makeup.[40] Similarly, the existence of an effective mechanism for resolving internal disputes is a critical factor contributing to the sustainability of community-managed schemes. The study queried if there were any disputes related to a water supply and/or WSS subproject, whether they were being resolved, and if there were other disputes in the community as well. The study asked if the trend in water- and sanitation-related disputes had changed since the formation of the community organization. This set of indicators was included to explain the effectiveness of the community organization and other aspects having a bearing on the sustainability of the scheme.

[40] Experience indicates that, for a variety of social and vested interest reasons, an existing community organization is often rivaled by another group, or it breaks up into factions, with each faction claiming the ownership of the whole or part of the subproject.

35. A strong sense of ownership of the scheme among beneficiaries plays a significant role in bringing together the community to make collective decisions and abide by them. One important indicator for a stronger sense of ownership is the cash or in-kind contributions made toward the capital or running cost of the scheme. The study explored community contributions in terms of land allocated for the development of source or wastewater facilities. An assessment of the cost of the land provided at inception was made and compared with today's price. It was expected that this data might help explain if, besides other factors, a higher degree of community contribution leads to better prospects for sustainability.

36. The community ownership and degree of social mobilization in turn reflect the level of engagement between the project and community. While the project record revealed that communities were engaged at all stages of the project cycle, the study tried to collect community recall of the various community mobilization and health and hygiene education activities conducted under the project. The communities were asked (i) if any education sessions were held; (ii) how many of the community organization members, male and female, attended them; (iii) what linkages, if any, were developed with other development partners; (iv) if information, education, and communication materials (e.g., banners, posters, compact discs, videos, etc.) were used; and (v) whether the community organization received microcredit for its development programs during the project period. The same data was repeated to assess whether the community organization still receives any such support after the project to help determine if the vital follow-up and mentoring support is being provided. In the absence of such support, it is likely that the community organization may sooner or later become dormant, adversely affecting the sustainability of the scheme.

37. Evidence supporting no major repairs indicates in most contexts that the caretaking of the subproject has been highly effective. The number of breakdowns per month over the past year and average downtime provide a good insight into the state of system O&M, shedding light on the availability of spare parts; appropriateness of technology vis-à-vis the presence of a supply chain; and capacity of community organization members and caretakers to mobilize human, monetary, and machine resources to address the fault. The longer the downtime, the poorer the reliability of the water-supply systems; damaging willingness to pay and endangering the sustainability of the scheme.

38. The system of payment acts as an indicator of an effective O&M system for both water and sanitation systems. If payments are graded by ability to pay, or if payments are made regularly irrespective of the occurrence of breakdowns, the system is considered effective. On the other hand, there may be a system of contributions made by most as and when the breakdown occurs. Since such a system often is not binding, its sustainability is questionable.

39. A working system of reporting problems with a subproject is important to ensure customer satisfaction and willingness to pay for services. In the absence of a working system of reporting and a redress mechanism, customer trust is lost, resulting in poor willingness to pay and ultimately leading to poor cost recovery and a decline in service-delivery standards. A vicious cycle of poor cost recovery leading to poor service delivery becomes too difficult to break once trust in the system is lost.

40. An active community organization tends to have an organized O&M system with spare parts available. As rural WSS subprojects influence rural women the most, it is always desirable that women play their due role in all stages of the project cycle, from planning and design to O&M. Although, culturally, women's active involvement is still restricted in many areas, especially in the more practical aspects of O&M, to gain a better understanding, the study asked

if, in some instances, women have taken up this role and what problems they face in discharging their O&M responsibilities.

41. A collection system must at least recover all operational expenditures. Inability to do so inevitably causes schemes to fall into disrepair and close down for failing to pay their bills, primarily for electricity, which is the major expenditure except in the case of gravity schemes. The study collected income and expenditure data from community organizations for the first 3 months to allow a comparison of revenues and expenses and to establish if schemes in general recovered all costs.

10. Data Collection Methodology

42. The study employed a mixed-method approach using a modular data-collection instrument. These modules covered a variety of subproject data covering technical, social, institutional, financial, and behavioral observations; physical inspection; and community perceptions. Data collection was both quantitative and qualitative. The methodology is discussed next.

11. Sampling Design and Sample Size

43. Seven districts were selected for the study using a stratified random-selection procedure representing relevant development interventions, including (i) both sector projects, (ii) new and rehabilitated subprojects, and (iii) water supply and WSS subprojects. The study covered two control villages for the "without project" scenario in each of the study districts. The distribution of sample subprojects by district for project area (treatment) households is presented in Table A6.3. The control villages were similar to the project villages except for the provision of ADB-supported water supply or WSS subprojects and are considered counterfactuals.

Table A6.3: Distribution of Sample Schemes for the Study by District

District	Subprojects		Total
	Project	Control	
Bahawalpur	22	2	24
Chakwal	21	2	23
Dera Ghazi Khan	18	2	20
Faisalabad	7	2	9
Rahim Yar Khan	21	2	23
Rawalpindi	17	2	19
Sargodha	9	2	11
Total	**115**	**14**	**129**

Source: Public Health Engineering Department, Government of Punjab, Lahore.

44. Time and budgetary limitations permitted the selection of 115 subprojects covering seven districts with the proportional representation discussed above. This resulted in a larger number of subprojects in Bahawalpur than in other districts (Table A6.3). The northern districts of Chakwal, Faisalabad, Rawalpindi, and Sargodha; and the southern districts of Bahawalpur, Dera Ghazi Khan, and Rahim Yar Khan had roughly equal representation in the sample.

12. Design of Data Collection Instruments

45. The study team prepared a scheme-level data-collection instrument for recording site inspections, focus group discussions, and general observations to assess the sustainability of the subprojects. The instrument covered both technical and community organization information in 10 modules. The specific indicators are summarized in Table A6.4. The study team pre-tested the data-collection instrument in one subproject in Rawalpindi District and modified it according to feedback from respondents. Particular care was taken to ensure that the wording of the questions was user friendly and clearly understood by an average respondent in the community. The revision required only minor modifications.

Table A6.4: Composition of Data Collection Instrument for Technical and Community Organization Assessment

Module and Contents		Respondent(s)
I.	**Basic Profile of CO and the Subproject.** Location of the subproject and water source, status of CO, status and type of subproject water source, alternative source of drinking water, history of conflicts in the community, and conflict resolution mechanism	Focus group discussions with CO members managing the subproject
II.	**Delivery and Impact of Training Given by the Project.** Gender disaggregated number and type of trainings undertaken by CO members, feedback on the effectiveness of training based on CO improvement, and impact of training in the wider community	Focus group discussions with CO members managing the subproject
III.	**CO Maturity.** Quality and effectiveness of CO leadership, management style, financial and accounting system transparency, existence and clarity of bylaws for CO operation, interaction between CO and community, capacity of CO members, linkages developed by CO, and record-keeping and documentation.	Focus group discussions with CO members managing the subproject
IV.	**Community Perceptions about the Quality of Water and Access to It.** Availability and regularity of water flow from the source throughout the year, decision about the selection of source point, effectiveness of reporting problems, quality of water, and present condition of the subproject.	Focus group discussion with members of the wider community
V.	**Repair, O&M, Revenues, and Expenditure Associated with Subproject.** Review of records maintained for repair and O&M, method of revenue collection adopted, constraints on revenue collection, toolkit and spare parts with the caretaker, and comparison of revenue and expenditure.	Focus group discussions with CO members managing the subproject
VI.	**Quality of Works.** Identification of issues and problems related to source, storage points, transmission system, pumps and distribution system, and obstacles to equitable water supply to different zones	Physical inspection by the study team to assess current state of the subproject

VII.	**Technical Assessment of Subprojects.** Presence of motor control unit and voltage regulator and discharge meter and their functional status Availability of scheme planning and monitoring tools such as layout plan and strata chart, skill of the caretaker in properly starting and closing the pump in the case of mechanized pumping schemes	Site visits by the study teams, discussion with caretaker and CO members, and physical inspection
VIII.	**Community Perception about Source Water Quality Testing and History of Laboratory Tests.** Water quality testing record of the scheme, record of disinfection, condition of basic disinfection equipment at source point, and, if arsenic was ever found, arsenic treatment measures and results	Discussion with CO members and caretakers
IX.	**Checklist of Sanitary Inspection of Water Source and Distribution Sites.** Sanitary condition of the source and storage point, parts of source and storage point exposed to contamination, procedures used to disinfect the source and storage, results of bacteriological tests conducted for source and storage, and sanitary condition of surroundings of the source and storage point	Sanitary inspection by the study team member
X.	**Laboratory Testing of Drinking Water Quality.** The pH of samples, bacteriological results, amount of total dissolved solvents, physical features of water (color, odor, taste, and turbidity), and chemical parameters (arsenic, fluoride, and nitrite/nitrate).	Laboratory tests

CO = community organization, O&M = operation and maintenance.
Source: Supplementary Appendix B.

46. A 2-day hands-on training session was held for two experienced supervisors and four research assistants selected for data collection. The trainers—a study coordinator and socio-technical specialists—ensured that all issues and questions were fully understood. Under the supervision of the study coordinator, the trainees completed mock interviews, and outstanding issues and difficulties were identified. These were resolved on the spot, and a common understanding of terms, concepts, and definitions was achieved.

47. As indicated in Table A6.4, modules VII, IX, and X provided data for the technical assessment of subprojects. These modules used structured quantified participatory assessment methodology, which is a variety of participatory and other methods to collect information from the field. A distinctive feature is the collection of qualitative information in quantitative form. This allows project management to view a large amount of qualitative information on a spreadsheet and distinguish rapidly between satisfactory and unsatisfactory performance. It is a versatile methodology that can be adapted to suit the needs of each assessment.[41]

[41] The roots of quantified participatory assessment lie in the methodology for participatory assessment, which was developed by a multidisciplinary global team working on the 15-country participatory learning and action study of the Water and Sanitation Program. The methodology uses participatory tools to generate community responses to particular questions. It then uses descriptive categories to assign a score to these responses. The method thus uses standard participatory rapid appraisal tools to generate the required information and adds only the dimension

13. Conduct of Data Collection Exercise and Quality Assurance

48. The research assistants completed observation and inspection under close supervision. The supervisors themselves conducted focus group discussions, and the specialists and study coordinator conducted technical assessment. The research assistants received on-the-spot guidance from their supervisors. The supervisors manually checked all questionnaires for completeness and sought additional clarification as and when required. Debriefing and planning meetings took place every evening. Supervisors provided regular updates to the study coordinator.

14. Data Management

49. To ensure the accuracy in data entry, the study adopted a double-entry management system using Access® software to ensure the internal consistency of data. Preliminary statistical analysis was based on outputs generated by the Statistical Package for Social Scientists, or SPSS®, software (V15.0). The study used descriptive statistics and graphical presentation of results. The survey dataset is available from IED (Supplementary Appendix C).

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of ordinal descriptive scoring to convert this qualitative information into numbers. Both self-scoring and peer group scoring are possible in quantified participatory assessment, depending on the time available and the nature of the respondents. The data are analysed using simple statistical tools such as frequency tables to show the number of habitations reporting a particular score. Communities, municipalities, or districts are classified according to benchmark scores.

IMPACT EVALUATION RESULTS

A. Project versus Comparison Communities, Households, and Respondents

1. The results indicated that the project and comparison communities were statistically similar in most aspects, including public facilities such as schools (except for primary schools), health facilities, garbage collection and disposal, transportation, population, and major livelihood sources (Supplementary Appendix D).[1] The only exceptions were the presence of water system and access to primary schooling, with better conditions in the project communities. Approximately 92% of the project communities had a water supply system, while only 8% of the comparison communities did. Similarly, a smaller proportion of households depended on hand pumps in project areas (24%) than in comparison areas (54%). More households were served by tubewells in project areas (40%) than in non-project areas (24%). A higher percentage of project communities had a primary school than did comparison communities (97% versus 87%).[2] On average, the distance to primary and middle schools was shorter in project areas than in non-project areas. Almost all households surveyed in both project and comparison communities enjoyed access to electricity, when available. Occupationally, both groups lived primarily by crop production (60%), followed by trading (14–17%), livestock rearing (12%), manufacturing (3%), and selling labor (9%–10%).

2. Respondent and household characteristics in the project and comparison communities were similar (Supplementary Appendix D). No statistical differences were observed in household head attributes (education, occupation, and sector of employment), household size, per capita expenditure on health, or housing attributes (roofing, walls, ownership, source of cooking fuel, and access to electricity).[3] The respondents in the two areas were statistically similar in terms of average age and gender composition but differed in years of schooling (5.1 years in project versus 4.8 years in comparison communities). An average household had six members with a balanced gender ratio of 50:50. Average per capita expenditure stood at PRs1,500,[4] which is comparable to other studies. Per capita expenditure on health and education for a school-attending child amounted to PRs47 and slightly over PRs300, respectively. No marked differences were observed with respect to asset ownership, employment, or sector engagement of the respondent households. The housing attributes differed between the two groups, with project households having a higher total number of rooms and sleeping rooms and more improved floors than comparison households.

B. Intermediate Project Outcomes

3. Table A7.1 shows that the projects had significant impact on water supply-related intermediate outcomes but not on sanitation. These outcomes included the supply of water for all types of uses: drinking, cooking, hand washing, toilet use, other domestic use, and livestock. Significantly higher proportions of households in the treatment villages had water available on their premises than did comparison households. The two types of households were, however,

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[1] The similarities of project and comparison communities reflect the conscious selection of villages comparable to each of the project villages.
[2] The difference in mean was statistically significant at 1%.
[3] The similarity in respondent household characteristics in project and non-project areas is expected as a result of the randomized selection of respondent households in each of project and non-project areas. The randomized selection normalizes the distribution of households, capturing a representative set per enumeration area.
[4] This amount compares well with the most recent estimate provided by the Pakistan Federal Bureau of Statistics in its 2005–2006 round of the Household Integrated Economic Survey on per capita household monthly expenditure of PRs1,518 for all of Pakistan, PRs1,252 in rural areas, and PRs2,042 in urban areas.

similar with respect to sanitation practices, with four in five houses having a toilet on their premises but only a little more than one fourth of them having covered sewers. All households in both treatment and comparison areas reported using one or more form of cleaning agents for hand washing. However, per capita monthly expenditures on water for all purposes, as well as for drinking, were significantly lower in treatment households than in comparison households. An average treatment household spent PRs22.58 per capita, and the average comparison household PRs31.32, reflecting 28% lower cost. Similarly, per capita expenditure on drinking water amounted to PRs20.40 in treatment households, or 21% less than the PRs25.83 spent by comparison households. Only 3% of the households treated their drinking water, with no significant difference between household types.

Table A7.1: Intermediate Outcomes of Water and Sanitation Provisions

	Project		Non-Project				Sig.
Variables	**Mean**	**Freq.**	**Mean**	**Freq.**	**Diff.**	**T**	**Level**
Water on premises (proportion):							
Drinking	0.952	1,301	0.843	1,301	0.108	9.254	0.000
Handwashing	0.964	1,301	0.862	1,301	0.102	9.392	0.000
Cooking	0.958	1,301	0.851	1,301	0.108	9.504	0.000
Toilet facility	0.971	1,289	0.873	1,275	0.098	9.464	0.000
Other domestic uses	0.972	1,300	0.869	1,301	0.102	9.802	0.000
Livestock	0.932	941	0.865	896	0.067	4.799	0.000
Sanitation (proportion)							
Toilet facility in house	0.819	1,301	0.812	1,301	0.007	0.454	0.650
Use cleaning agent in handwashing	0.998	1,301	1.000	1,301	(0.002)	(1.415)	0.157
Covered sewerage	0.272	1,301	0.283	1,301	(0.011)	(0.613)	0.540
Water treatment and expenditure							
Households that treat drinking water (proportion)	0.035	1,301	0.026	1,301	0.008	1.257	0.209
Per capita monthly expenditure on drinking water[a] (rupees)	20.395	1,037	25.832	251	(5.438)	(3.609)	0.000
Per capita monthly expenditures on water[a,b] (rupees)	22.580	840	31.320	228	(8.740)	(4.655)	0.000

( ) = negative, Diff. = difference, Freq. = frequency, Sig. = significance, T = student's t-statistics.
Notes: [a] Excludes those who reported zero expenditure.
[b] Substantial number of households did not provide breakdown on expenditures.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

4. The sources relied on for drinking water varied significantly between treatment and comparison households. Table A7.2 reveals that a significantly higher proportion of households in the treatment households relied on piped water, while comparison households relied mostly on hand pumps, shallow tubewells, or boreholes. Seventy-one percent of project households relied primarily on piped water, compared with only 10% of comparison households, while 70% of comparison households relied on tubewells or boreholes (39% versus 17% of the project households) or hand pumps (31% versus 6% of the project households). Very few households depended on wells or rainwater in either area, though significantly more among comparison households. A significantly smaller proportion of households in the project households depended on alternative water sources outside of their household premises. Supplementary Appendix D provides more details on sources of water for uses other than drinking.

Table A7.2: Alternative Sources of Drinking Water
(proportion of households)

Variables	Project Mean	Project Freq.	Non-Project Mean	Non-Project Freq.	Diff.	T	Sig. Level
Drinking Water							
In premises:							
piped into dwelling	0.706	1,301	0.100	1,301	0.606	40.028	0.000
piped into yard/plot	0.002	1,301	0.000	1,301	0.002	1.415	0.157
hand pump	0.061	1,301	0.314	1,301	(0.252)	(17.399)	0.000
tube well or borehole	0.166	1,301	0.390	1,301	(0.224)	(13.147)	0.000
protected well	0.016	1,301	0.029	1,301	(0.013)	(2.240)	0.025
unprotected well	0.001	1,301	0.007	1,301	(0.006)	(2.537)	0.011
rainwater	0.000	1,301	0.004	1,301	(0.004)	(2.240)	0.025
Outside of premises:							
public tap/stand pipe	0.001	1,301	0.018	1,301	(0.017)	(4.528)	0.000
hand pump	0.019	1,301	0.058	1,301	(0.038)	(5.123)	0.000
tube well or borehole	0.006	1,301	0.028	1,301	(0.022)	(4.375)	0.000
protected well	0.007	1,301	0.012	1,301	(0.005)	(1.407)	0.160
unprotected well	0.002	1,301	0.007	1,301	(0.005)	(2.116)	0.034
protected spring/kare	0.009	1,301	0.019	1,301	(0.010)	(2.154)	0.031
unprotected spring	0.001	1,301	0.005	1,301	(0.005)	(2.126)	0.034
pond	0.002	1,301	0.008	1,301	(0.007)	(2.504)	0.012
others	0.002	1,301	0.001	1,301	0.002	1.001	0.317

( ) =negative, Diff. = difference, Freq. = frequency, Sig. = significance, T = student's t-statistics.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

5. The study assessed the difficulty of fetching water in the project and non-project households based on the total and average time spent and the distance traveled in fetching water. The computation considered those with water on the premises as spending no time and traveling no distance to fetch water. Table A7.3 indicates that the time spent and distance traveled to fetch water in project households were approximately one third those of comparison households. Supplementary Appendix D provides more detailed information on frequency, time spent, and distance traveled per trip.

Table A7.3: Time Spent and Distance Travelled Fetching Water per Week

Variables	Project Means	Project Freq.	Non-Project Means	Non-Project Freq.	Diff	T	Sig. Level
Time (in mins.) for fetching water, per week							
Total, all uses	42.637	1,301	132.707	1,301	(90.07)	(6.06)	0.00
Average, all uses	7.571	1,299	24.828	1,297	(17.26)	(6.42)	0.00
Fetching water for drinking	9.150	1,299	23.733	1,286	(14.58)	(5.20)	0.00
hand washing	6.887	1,298	22.749	1,289	(15.86)	(5.92)	0.00
cooking	7.545	1,298	23.709	1,287	(16.16)	(5.89)	0.00
toilet	4.786	1,287	21.793	1,263	(17.01)	(6.66)	0.00
other domestic uses	4.745	1,298	21.846	1,291	(17.10)	(6.73)	0.00
livestock	13.493	929	30.329	876	(16.84)	(3.14)	0.00
Distance (in kms.) for fetching water, per week							
Total, all uses	1.943	1,301	6.982	1,301	(5.04)	(7.84)	0.00
Average, all uses	0.353	1,292	1.322	1,292	(0.97)	(8.03)	0.00
Fetching water for drinking	0.462	1,292	1.443	1,279	(0.98)	(6.67)	0.00
hand washing	0.304	1,291	1.188	1,285	(0.88)	(7.41)	0.00
cooking	0.342	1,291	1.291	1,281	(0.95)	(7.66)	0.00
toilet	0.198	1,280	1.051	1,260	(0.85)	(7.90)	0.00
other domestic uses	0.197	1,291	1.110	1,286	(0.91)	(8.23)	0.00
livestock	0.639	923	1.497	872	(0.86)	(3.80)	0.00

( ) = negative, Diff. = difference, Freq. = frequency, Sig. = significance, T = student's t-statistics.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

C. Project Impact on Household Welfare

6. The study assessed project impact on household welfare based on the intended impact at project design and reported achievements at project completion The study identified three relevant impact areas in the context of the two sector projects—health, education, and labor activity. The analysis was extended to evaluate the impact on different socioeconomic groups. A discussion on these impacts based on household survey data follows.

1. Impact on Health

7. Health impact was evaluated in terms of (i) incidence of waterborne illnesses, diarrhea in particular, and (ii) reduction in drudgery associated with fetching water, often reported as muscle strain, blisters, heat strokes, and back pain. The study examined the incidence of diarrhea and the number of resulting sick days. The incidence of diarrhea in the study areas was 1.8% for all ages and 6% for children 5 years and under—numbers substantially lower than those reported in other studies.[5] Four weeks prior to the survey date was used as a cutoff point for incidence because the survey in August–October 2008 was during a long dry spell.

8. The survey results show that the incidence of diarrhea and the mean number of resulting sick days in the project area were marginally lower than in comparison areas but not statistically significant (Table A7.4). This result holds for all ages, including children 5 years old and younger. However, significantly fewer household members suffered from drudgery in project areas (3.2%) than in comparison areas (8.4%).[6]

Table A7.4: Health Impacts in Project and Non-Project Areas

Variables		Project		Non-Project				Sig.
		Mean	Freq.	Mean	Freq.	Diff.	T	Level
Diarrhea incidence,	All	0.018	7,682	0.018	7,520	0.001	0.37	0.710
	5 and under	0.058	886	0.061	756	(0.003)	(0.28)	0.779
Diarrhea sick days,	All	3.128	141	3.341	132	(0.213)	(0.57)	0.569
	5 and under	2.255	51	2.543	46	(0.289)	(0.44)	0.662
Pain[a] from fetching water		0.032	1,295	0.084	1,301	(0.051)	(5.62)	0.000

( ) = negative, Diff. = difference, Freq. = frequency, Sig. = significance, T = student's t-statistics.
[a] Muscle strain, blisters or back ache.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

9. Recognizing the limitations associated with the comparison of proportions and means, as discussed in Appendix 6, there was a need to establish causality while controlling for variables other than the projects, so the survey data was subjected to multivariate analysis.[7]

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[5] The Demographic and Health Survey conducted by the Institute of Population Studies of Pakistan and Macro International Inc. in 2008 estimated that the incidence of diarrhea in children below 6 years of age in Punjab was 21% in 2006–2007. The Pakistan Social and Living Standards Measurement Survey conducted by the Government of Pakistan reported that 11% of the children 5 years of age and under in rural areas of Punjab suffered from diarrhea in 2006–2007. In both studies, incidence was within 2 weeks preceding the survey date.

[6] $P<0.001$.

[7] Due to the binary nature of the dependent variable, probit estimation procedure was applied for modeling diarrhea incidence. As the number of sick days from diarrhea was recorded as count data, the poisson regression model was used for estimation. Recall that in estimating treatment effects using a nonlinear model (e.g., probit) the

Estimation results show that none of the personal characteristics were significantly different between project and non-project areas. There were, however, several significant differences in the household characteristics. The education of the household head was found to be significantly lower in project areas, and project households had more members than comparison households. Further, a higher proportion of household heads in project areas worked in agriculture and services. Housing conditions were better in project areas than in comparison households. With respect to community characteristics, project communities had better education, health, and transport facilities.

10. Table A7.5 shows that diarrhea incidence and the severity of illness measured by sick days for all members and children 5 years and under were not found to be significantly different between project and non-project areas. These results do not lend support to the claim in the project completion report of the Punjab Community Water Supply and Sanitation (Sector) Project (PCWSSP) that the project was successful in reducing the incidence of waterborne diseases (para. 31) but are consistent with the earlier results[8] and the village-matching result in Jalan and Ravallion,[9] which showed no significant impact on health as a result of water supply interventions. The low incidence of diarrhea in the sample households may have made it difficult for the project to have further positive impact. In the case of drudgery, measured by the proportion of children suffering muscle strain, blisters, or back ache associated with fetching water, the impact was negative and statistically significant, suggesting that the presence of the project reduced drudgery associated with fetching water. The estimated marginal effect[10] shows that the reduction in the proportion attributable to the project is about 5%. Note that the regression estimates simply replicate the results of the comparison of means, indicating that there were no confounding impacts from other causes. Even the estimate of the impact on drudgery is virtually identical. The full estimation results are given in Supplementary Appendix D.

Table A7.5: Impact on Health

Health Impact	Impact Estimate	Significance Level
A. Waterborne Disease		
Diarrhea incidence, All ages	0.002 [a]	0.521
Diarrhea incidence, 5 and under	0.003 [a]	0.812
Diarrhea sick days, All ages	0.853 [b]	0.167
Diarrhea sick days, 5 and under	0.901 [b]	0.727
B. Drudgery		
Pain from fetching water[c]	(0.051) [b]	0.000

[a] Pain from fetching water refers to muscle strain, backache, and blisters.
[b] Marginal effect.
[c] Incidence rate ratio.
Source: Supplementary Appendix D.

method of propensity score is recommended and hence was applied in the analysis. The propensity score estimates, besides generating control functions, can be used to describe the characteristics of project households vis-à-vis those in the comparison communities ex post or at the time of the survey.

[8] Fewtrell, L. and J. Colford. 2004. Water, Sanitation and Hygiene: Intervention and Diarrhea: A Systematic Review and Meta Analysis. *Health Nutrition and Population DP No. 34960*. Washington, DC: World Bank.

[9] Jalan, J. and M. Ravallion. 2003. Does Piped Water Reduce Diarrhea for Children in Rural India? *Journal of Econometrics*, vol. 112, pages 153–73.

[10] This is a probit regression, and the impact of the project is given by the marginal effect.

2. Impact on Education

11. Project impact on education was measured in three ways: (i) school attendance at different levels, (ii) households with children refusing to go to school for lack of clean drinking water, and (iii) households with children refusing to go to schools for lack of or poor toilet facilities. The study found that the school attendance rates were higher in project areas than in non-project areas. However, the differences were not significant except among 11–13 year olds (middle school) and 14–17 year olds (high school). For both sexes, attendance rates by age group was 77–80% for 6–10 years (primary), 73–80% for 11–13 years (middle school), 52–59% for 14–17 years (high school), and 19% for 18–24 years (tertiary) (Table A7.6). Attendance rates by gender revealed a consistent pattern for girls, demonstrating for the same age groups (11–13 and 14–17) significant differences between project and comparison groups (79% versus 70% for 11–13 years, and 53% versus 45% for 14–17 years). A narrow difference was observed for boys aged 14–17 years (65% versus 58%). The survey estimates were on the high side of existing estimates for Punjab.[11] The study observed that significantly fewer project households had children not going to school for lack of clean water than did comparison areas (2% versus 4%). On the other hand, there was no significant difference in the proportion of households with children not going to school for lack of toilet facilities, with the proportion being 4–5%.

Table A7.6: Education Indicators in Project and Non-Project Areas
(proportion)

Variables		Project		Non-Project				Sig.
		Mean	Freq.	Mean	Freq.	Diff.	T	Level
Proportion Attending:								
All	6–24 years	0.507	1,111	0.496	1,136	0.011	0.61	0.541
	6–10 years	0.804	535	0.774	553	0.030	1.30	0.194
	11–13 years	0.800	437	0.733	450	0.067	2.40	0.016
	14–17 years	0.589	528	0.520	552	0.070	2.45	0.014
	18–24 years	0.193	669	0.185	664	0.008	0.41	0.681
Female	6–24 years	0.468	891	0.450	897	0.018	0.82	0.414
	6–10 years	0.774	316	0.762	315	0.012	0.36	0.718
	11–13 years	0.785	214	0.701	242	0.084	2.07	0.039
	14–17 years	0.531	292	0.449	319	0.082	2.07	0.039
	18–24 years	0.145	452	0.150	446	(0.005)	(0.24)	0.812
Male	6–24 years	0.578	884	0.546	922	0.032	1.52	0.128
	6–10 years	0.825	360	0.782	393	0.043	1.55	0.122
	11–13 years	0.802	262	0.781	254	0.020	0.56	0.575
	14–17 years	0.646	356	0.582	359	0.064	1.81	0.071
	18–24 years	0.239	428	0.211	419	0.027	1.00	0.317
Not going to school due to lack of water (prop.)		0.020	1,295	0.038	1,301	(0.018)	(2.68)	0.007
Not going to school due to lack of toilet (prop.)		0.040	1,295	0.047	1,301	(0.007)	(0.84)	0.401

( ) = negative, Diff. = difference, Freq. = frequency, Sig. = significance, T = student's t-statistics.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

12. Multivariate regression analysis results are summarized in Table A7.7. Estimation results show that the projects had a significant positive impact on attendance, particularly in high school (14–17 years) and for girls. The projects contributed to increasing school attendance by children

[11] The net primary attendance rate in the Demographic and Health Survey 2007–2006 was 75.0% for both sexes, 76.5% for males, and 73.2% for females. For middle, the estimated net enrolment rate for Punjab was 31.2% for both sexes, 31.9% for males, and 30.6% females. The Pakistan Social and Living Standards Measurement Survey 2006–2007 found the net primary enrolment rate in Punjab Province to be 66%, 67% for males, and 65% for females. For middle school, the net enrolment rate was estimated at 34% for both sexes, 36% for males, and 32% for females.

in households who had previously refused to go to school for lack of clean water. Marginal effect estimates show that the projects under review increased the proportion of all children attending high school by 5% and of girls by 8%. This result supports the claim in the project completion report for the PCWSSP. The study findings differed from Khandker[12] and revealed that the project contributed to a 2% increase in the number of households sending their children to school because clean water was available.

13. A comparison of the differences in proportion in Table A7.6, and of the marginal effects in Table A7.7, indicate some confounding effects. Some of the differences that were found to be significant in the comparison of means were no longer significant in the multivariate regression results (i.e., total and disaggregated proportion of 11–13 year olds attending school). There were also differences in the magnitude of the impact derived from the differences in proportions and those from the multivariate models. For instance, while the impact from differences in the proportion of young persons aged 14–17 and attending school was 7%, the multivariate estimate is only 5%. For girls in high school the estimated impact from the differences in proportion was 8.2% and in the multivariate model was 8.4%. Supplementary Appendix D contains the full estimation results.

Table A7.7: Impact of Water Supply and Sanitation Intervention on Education

Impact on School Enrolment		**Marginal Effects**	**Significance Level**
Proportion enrolled by age group			
All	6–24 years	(0.008)	0.676
	6–10 years	0.028	0.282
	11–13 years	0.046	0.135
	14–17 years	0.053	0.092
	18–24 years	(0.016)	0.468
Female	6–24 years	0.002	0.929
	6–10 years	0.019	0.610
	11–13 years	0.068	0.136
	14–17 years	0.084	0.061
	18–24 years	(0.036)	0.164
Male	6–24 years	0.038	0.163
	6–10 years	0.038	0.437
	11–13 years	(0.072)	0.475
	14–17 years	0.110	0.113
	18–24 years	0.008	0.843
Household reporting children not going to school due to lack of water (proportion)		(0.018)	0.006
Household reporting children not going to school due to lack of toilet (proportion)		(0.011)	0.205

( ) = negative.
Source: Supplementary Appendix D.

3. Impact on Labor Supply

14. Young household members' participation in the labor force and average number of hours worked per week, using hours worked in the past week as a reference, were measures associated with project impact on labor activity. Based on difference in the means, the estimates show that the projects had no significant impact on labor force participation or hours worked

[12] Khandker, S. 1996. Education Achievements and School Efficiency in Rural Bangladesh. *World Bank Discussion Paper* No. 319. Washington, DC.

except in the 11–17 age group. In this age group, project household members' labor force participation rate was 2% less, and individuals worked 5 hours per week longer than did comparison communities. Household survey data suggested that on average the labor force participation rate was 30% for the individuals 10 years and above, 4–6% for 11–17 year olds, and 24–26% for 18–24 year olds. No statistical difference was found between project and comparison respondents (Table A7.8). These estimates are lower than the most recent estimate from the Labor Force Survey of the Pakistan Federal Bureau of Statistics for 2006–2007.[13] Table A7.8 indicates that people 10 years and above worked for about 58 hours per week. However, 11–17 year olds worked significantly longer hours in project areas than in comparison areas (57.6 versus 52.3 per week).

Table A7.8: Labor Force Participation and Hours Work in Project and Non-Project Areas

Variables		Project Mean	Project Freq.	Non-Project Mean	Non-Project Freq.	Diff.	T	Sig. Level
With job (proportion),	10 years and above	0.301	6,118	0.308	6,112	(0.008)	(0.940)	0.347
	11–17 years[a]	0.043	1,344	0.059	1,398	(0.016)	(1.844)	0.065
	18–24 years	0.235	1,223	0.260	1,216	(0.025)	(1.442)	0.149
Hours worked per week,	10 years and above	58.457	1,810	58.135	1,850	0.322	0.649	0.516
	11–17 years[a]	57.552	58	52.263	76	5.289	1.830	0.070
	18–24 years	57.117	281	56.632	310	0.485	0.381	0.703

( ) = negative, Diff. = difference, Freq. = frequency, Sig. = significance, T = student's t-statistics.
[a] Age groups 11–13 and 14–17 merged to increase cell sample size.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

15. To account for the likely difference in household and community characteristics, a regression model[14] was estimated for each of these indicators using individual, household, and community controls. The results suggest that the projects had no significant impact on labor supply (Table A7.9). The simple comparison of means, however, showed significant impacts on both labor force participation and the average hours worked by 11–17 year olds. This indicates confounding variables. Given that the computed labor force participation rate is low on average compared with other estimates, the no-significant-impact result is surprising. The results differ from the Ilahi and Grimard (2000)[15] study, which noted significant impact on labor marketing time arising from better access to water, at least for women. Given the already high average hours worked, the result is less surprising. Supplementary Appendix D shows the full estimation results.

[13] Available: www.statpak.gov.pk/depts/fbs/publications/lfs2006_07/lfs2006_07.html. It reported labor force participation at 48.6% for all of Punjab (52.1% in urban areas and 41.6% in rural areas). The age group–specific labor force participation rate was 13.3% for ages 10–14, 37.4% for ages 15–19, and 53.0% for ages 20–24, based on the average hours worked in the previous week.
[14] Labor force participation, being a binary variable, was estimated using a probit model, while hours worked, being a continuous variable, was estimated using the ordinary least square method.
[15] Ilahi, N. and F. Grimard. 2000. Public Infrastructure and Private Costs: Water Supply and Time Allocation of Women in Rural Pakistan. *Economic Development and Cultural Change*, Vol. 48(4), pages 45–75.

Table A7.9: Impact on Labor Force Participation and Work Hours

Labor Supply Impact	Impact Estimate	Significance Level
Labor force participation rate (respondents proportion with job)		
10 years and above	(0.006) [a]	0.489
11–17 years	(0.014) [a]	0.136
18–24 years	(0.018) [a]	0.354
Hours worked per week		
10 years and above	0.613 [b]	0.719
11–17 years	59.013 [b]	0.899
18–24 years	(98.986) [b]	0.388

( ) = negative.
[a] Marginal effects. [b] Coefficients.
Source: Supplementary Appendix D.

4. Impact on Socioeconomic Groups[16]

16. Multivariate analysis of socioeconomic groups revealed some interesting results. While the impact of water supply and sanitation (WSS) interventions on reducing the incidence of diarrhea was insignificant for all age groups and for children aged 5 and under, disaggregated analysis demonstrated a significantly positive relationship for the lowest socioeconomic group, a significantly negative relationship for the middle socioeconomic group, and an insignificantly negative relationship for the highest socioeconomic group (Table A7.10). This means that the benefits from the projects in terms of reducing diarrhea incidence existed only for the middle socioeconomic group, but not for the lowest, as one would have expected as the projects were in disadvantaged rural areas. The findings differ from Gross, et al.,[17] who noted that there was no differential impact of water supply on diarrhea in lower and upper socioeconomic groups. However, no significant impact was found with respect to diarrhea incidence in children 5 years and below, or on the duration of diarrhea, for all the socioeconomic classes. The insignificant average impact on these variables is shown here to mean insignificance for all socioeconomic classes. In the case of drudgery, the reduction was highly significant in the lowest socioeconomic group and mildly significant for the highest. The full estimation results appear in Supplementary Appendix D.

[16] Although income and expenditure are the most common indicators of socioeconomic status, their use was considered problematic because they were endogenous. The education of the household head, on the other hand, was highly correlated with household income but was considered exogenous because it would have most likely been earned before the project. To represent different socioeconomic status, the education of the household head was divided into three categories: (i) up to class 5, or primary; (ii) class 6–10, or middle and high school, and (iii) class 11 and above, or tertiary.

[17] Gross, R., B. Schell, M.C. Molina, M.A. Leao, and U. Strack. 1989. The Impact of Improvement of Water Supply and Sanitation Facilities on Diarrhea and Intestinal Parasites: A Brazilian Experience with Children in Two Low-Income Urban Communities. *Revista de Saude Publica*, Vol. 23(3), pages 214–220.

Table A7.10: Impact on Health by Socioeconomic Group

Health Impact	Marginal Effects on Socioeconomic Group		
	Lowest	Middle	Highest
A. Waterborne Disease			
Diarrhea incidence, All	0.005	(0.01) [a]	(0.00)
Diarrhea incidence, 5 and under	0.009	(0.02)	0.01
Diarrhea sick days, All	0.813	1.133	1.092
Diarrhea sick days, 5 and under	0.943	0.821	0.983
B. Drudgery			
Pain from fetching water	(0.039) [b]	(0.011)	(0.037)

( ) = negative.
[a] and [b] represent significance at 5% and 1% level.
Source: Supplementary Appendix D.

17. The projects had positive impact on school attendance, particularly among those in the middle socioeconomic group (all age groups except 11–13 years) and among 18–24 year olds in the highest group (Table A7.11). However, regressive impact was observed in the lowest socioeconomic group for 18–24 year olds. Further disaggregated analysis by gender revealed that the projects had positive impact on the enrolment of girls aged 6–10 and 14–17 in the middle socioeconomic group and modest impact on 18–24 year olds in the highest socioeconomic group. Significantly positive impact was noted for boys' enrolment in the middle socioeconomic group for all ages. Enrolment increased in the lowest socioeconomic group with the availability of water in schools. However, no significant impact was observed on households whose children refused to go to school for lack of toilet facilities. Supplementary Appendix D provides full estimation results.

Table A7.11: Project Impact on Education by Socioeconomic Group and Gender, Marginal Effects

	Marginal Effects on Socioeconomic Group		
Impact on School Enrolment	**Lowest**	**Middle**	**Highest**
All (by age group)			
6–24 years	(0.054)	0.106 [a]	0.043
6–10 years	(0.004)	0.098 [a]	(0.029)
11–13 years	0.006	0.118 [a]	(0.023)
14–17 years	(0.010)	0.148 [a]	0.044
18–24 years	(0.082) [a]	0.144 [a]	0.108 [b]
Female			
6–24 years	(0.032)	0.079 [b]	0.031
6–10 years	(0.030)	0.133 [a]	0.006
11–13 years	0.074	0.037	(0.157)
14–17 years	(0.003)	0.200 [a]	0.090
18–24 years	(0.067) [b]	0.053	0.090
Male			
6–24 years	(0.009)	0.120 [a]	0.015
6–10 years	0.002	0.122	(0.023)
11–13 years	(0.117)	0.187 [b]	0.020
14–17 years	(0.011)	0.313 [a]	0.153
18–24 years	(0.068)	0.156 [b]	0.136
Household reporting children not going to school due to lack of water (proportion)	(0.021) [b]	0.009	(0.003)
Household reporting children not going to school due to lack of toilet (proportion)	(0.013)	0.005	(0.002)

( ) = negative.
Note: [a] and [b] represent significance at 1% and 5%, respectively.
Source: Supplementary Appendix D.

18. The middle socioeconomic group experienced significant impact on labor supply. The 11–17 and 12–18 age groups had lower labor force participation rates (reduced by 3.8% and 9.8%, respectively), and the 11–17 year age group worked 14 hours less per week (Table A7.12). The result is consistent with the education impact, as some of the children who worked earlier may have opted to go back to school. No significant impact was observed in the lowest and highest socioeconomic groups' labor force participation or in hours worked per week. The full estimation result is given in Supplementary Appendix D.

Table A7.12: Impact on Labor Supply by Socioeconomic Groups

Labor Supply Impact	Marginal Effects on Socioeconomic Group		
	Lowest	Middle	Highest
Labor force participation rate (Respondents proportion with job)			
10 years and above	0.001	(0.020)	0.003
11–17 years	0.002	(0.038) [a]	(0.013)
18–24 years	0.022	(0.098) [a]	(0.021)
Hours worked per week			
10 years and above	0.793	0.348	(2.265)
11–17 years	25.790	(14.168) [b]	(30.982)
18–24 years	(95.982)	(0.405)	(0.833)

( ) = negative.
Note: [a] and [b] represent significance at 1% and 5%, respectively.
Source: Supplementary Appendix D.

D. Impact by Typology of the Subprojects

19. Broadly speaking, the subprojects were classified in three ways: (i) Punjab Rural Water Supply and Sanitation (Sector) Project (PRWSSP) versus PCWSSP for the timing and intensity of the WSS intervention; (ii) new construction versus rehabilitation; and (iii) water supply versus WSS. Each of the six types of subprojects was compared with their matching comparison communities to ascertain the impact of projects on health, education, and labor activity. The empirical results from the analysis are presented in terms of marginal effects in Table A7.13, and full estimation results appear in Supplementary Appendix D. The results with respect to differences in means are presented for comparison, but the discussion focuses on multivariate regression results.

1. Punjab Rural Water Supply and Sanitation (Sector) Project

20. Both comparison of means and multivariate analyses revealed that the project had no significant impact on the incidence or intensity of diarrhea among all ages, including children 5 years and under. However, drudgery reduction was greater among project residents than among comparison (control) residents. The reduction in drudgery was slightly higher under multivariate analysis than in the difference in mean (12.3% versus 11.8%). While school enrolment was 6.8% lower for 6–10 year olds in project areas, based on difference in mean, the multivariate results provided a quite different picture. Enrolment actually declined significantly by 16.3% for 6–10 year olds and by 10.5% for 18–24 year olds. While no statistical difference was observed, enrolment by 11–13 year olds actually increased by 4.7%. Interestingly, the impact was significant for the girls but insignificant for boys in all age groups. Approximately 3.8% more project households than comparison households had children going to school because clean water was available there. Similarly, 3.7% more project households than comparison households had children going to school because of the provision of toilets.

2. Punjab Community Water Supply and Sanitation Project

21. The analysis revealed that for PCWSSP subprojects results from the differences in means differed somewhat from the multivariate results because of confounding factors. While the incidence of diarrhea for all, including children under 5 years old, in project area was not significantly different from the incidence in comparison areas, the number of sick days was higher for all members in project areas by 0.75 days than in comparison areas (Table A7.13). This is somewhat surprising, but one reason may be that reported sick days might not necessarily have been related to water consumption. However, impact on drudgery reduction was reported at 5.4% with no statistical difference between project and non-project areas. The impact on education was significantly positive in project areas for 6–10 year olds. The effect was more pronounced for girls and was realized in both the 6–10 and 11–17 age groups. In fact, the project led to a 12.5% increase in the enrolment of girls aged 6–10 and 11.8% of girls aged 11–17. While enrolment increased for boys in all age groups, no statistical difference was found between project and comparison areas. Multivariate analysis showed no significant difference in impact on labor supply between the two areas.

3. Water Supply and Sanitation

22. The impact of WSS on health was noticeable only in terms of a 7.0% reduction in drudgery in project areas over comparison areas, but no significant differences were observed with respect to reduction in diarrhea. The WSS intervention led to a 5.3% reduction in enrolment by 18–24 year olds and an 8.6% increase in enrolment by 11–17 year olds girls (Table A7.13). The proportion of households with children not going to school for lack of water and toilet facilities in WSS areas are found to be 3.6% and 4.1% lower, respectively, than in comparison villages. The labor force participation rate for 18–24 year olds in project areas was estimated to be 5.5% lower than in comparison areas.

Table A7.13: Impact on Health, Education, and Labor Supply Outcomes by Type of Project; Matched Villages

Item		PRWSSP		PCWSSP		WSS		WS		NEW		Rehab.	
		Diff. in means or prop.	Multivariate	Diff. in means or prop.	Multivariate	Diff. in means or prop.	Multivariate	Diff. in means or prop.	Multivariate	Diff. in means or prop.	Multivariate	Diff. in means or prop.	Multivariate
A. Health Impact													
Waterborne Diseases													
Diarrhea incidence,	All ages[a]	(0.0002)	(0.0002)	0.0004	(0.0021)	0.0014	0.0018	(0.0012)	0.0009	0.0009	0.0013	(0.0013)	0.0010
	5 and under[a]	(0.0209)	(0.0002)	0.0068	0.0156	(0.0057)	(0.0036)	(0.0006)	0.0196	(0.0011)	(0.0020)	(0.0082)	(0.0028)
Diarrhea sick days,	All ages[b]	(0.3478)	1.1280	(0.3055)	0.7460 [e]	(0.7128)	0.8040	0.0155	0.8320	(0.6508)	0.8560	0.3314	1.0360
	5 and under[b]	0.9000	2.6980	(0.8792)	0.8700	0.6385	1.2790	(1.0400)	0.7800	(0.5144)	0.6860	0.3571	1.5530
Drudgery													
Pain from fetching water	[a]	(0.1180) [f]	(0.1227) [f]	(0.0077)	(0.0054)	(0.0631) [f]	(0.0700) [f]	(0.0397) [f]	(0.0397) [f]	(0.0676) [f]	(0.0677) [f]	(0.0110)	(0.0189)
B. Education Impact													
Proportion attending by age group[a]													
All	6–24 years [a]	(0.0164)	(0.0989) [f]	0.0297	0.0119	0.0128	(0.0290)	0.0099	0.0029	0.0080	(0.0267)	0.0199	0.0067
	6–10 years [a]	(0.0679)	(0.1629) [f]	0.0908 [f]	0.1121 [f]	0.0158	(0.0188)	0.0475	0.0397	0.0011	(0.0331)	0.0987 [e]	0.0903 [e]
	11–17 years[a]	0.0578	0.0469	0.0808 [f]	0.0454	0.0680 [e]	0.0609	0.0750 [e]	0.0261	0.0535	0.0116	0.1226 [f]	0.0833
	18–24 years[a]	(0.0213)	(0.1046) [f]	0.0300	(0.0060)	(0.0070)	(0.0534)	0.0277	0.0133	(0.0062)	(0.0525) [e]	0.0462	0.0612
Female	6–24 years [a]	(0.0107)	(0.1092) [e]	0.0361	0.0264	0.0116	(0.0382)	0.0233	0.0318	0.0276	(0.0181)	(0.0083)	(0.0191)
	6–10 years [a]	(0.0540)	(0.2154) [f]	0.0519	0.1245 [e]	(0.0009)	(0.0472)	0.0243	0.0686	0.0226	(0.0234)	(0.0104)	0.0015
	11–17 years[a]	0.0730	(0.0101)	0.0893 [e]	0.1176	0.0864 [e]	0.0531	0.0783	0.0957	0.0678	0.0213	0.1241 [e]	0.0830
	18–24 years[a]	(0.0525)	(0.1043) [e]	0.0303	(0.0348)	(0.0275)	(0.0510)	0.0237	(0.0007)	(0.0028)	(0.0397)	(0.0090)	(0.0313)
Male	6–24 years [a]	(0.0014)	0.0179	0.0546 [e]	0.0413	0.0438	0.0586	0.0192	0.0135	0.0167	0.0052	0.0703	0.0824
	6–10 years [a]	(0.0497)	0.0655	0.1005 [f]	0.1064	0.0395	0.0712	0.0498	0.0472	(0.0043)	0.0432	0.1526 [f]	0.0541
	11–17 years[a]	0.0185	(0.1054)	0.0720	0.0055	0.0349	(0.0895)	0.0649	0.1091	0.0192	(0.1825) [e]	0.1374 [f]	0.1341
	18–24 years[a]	0.0413	(0.0320)	0.0199	(0.0279)	0.0356	0.0164	0.0198	(0.0221)	0.0074	(0.0366)	0.0729	0.0370
Household reporting children not going to school due to lack of water (proportion)[a]		(0.0464) [f]	(0.0384) [f]	0.0013	(0.0016)	(0.0315) [**]	(0.0355) [f]	(0.0032)	(0.0049)	(0.0236) [f]	(0.0274) [f]	(0.0028)	(0.0193) [e]
Household reporting children not going to school due to lack of toilet (propotion)[a]		(0.0426) [f]	(0.0371) [e]	0.0180	0.0107	(0.0270) [*]	(0.0405) [f]	0.0159	0.0139	(0.0225) [e]	(0.0306) [f]	0.0358 [e]	0.0135
C. Labor Supply Impact													
Labor force participation rate (Respondents proportion with job)[a]													
	10 years and above[a]	(0.0094)	(0.0092)	(0.0060)	(0.0065)	(0.0111)	(0.0111)	(0.0033)	(0.0031)	(0.0114)	(0.0100)	0.0032	0.0004
	11–17 years[a]	(0.0011)	(0.0168)	(0.0248) [e]	(0.0164)	0.0099	0.0048	(0.0442) [f]	(0.0410) [f]	(0.0162)	(0.0143)	(0.0145)	(0.0097)
	18–24 years[a]	(0.0093)	(0.0440)	(0.0334)	(0.0320)	(0.0483) [e]	(0.0551)	0.0026	0.0003	(0.0216)	(0.0237)	(0.0228)	(0.0446)
Hours worked per week													
	10 years and above[c]	0.9452	1.7499	(0.1911)	(0.8968)	0.3277	2.0188	0.4484	(1.3960)	(0.0215)	(0.1039)	1.1330	3.6723
	11–24 years[d]	4.1042 [e]	4.4021	(0.6511)	20.4064	2.8980	(29.1879)	(0.0115)	69.5411	1.0464	(37.2017)	2.1532	36.7615

( ) = negative, Coef. = coefficient, Diff. = difference, PCWSSP = Punjab Community Water Supply and Sanitation (Sector) Project, PRWSSP = Punjab Rural Water Supply and Sanitation (Sector) Project, Rehab. = rehabilitated, WS = water supply, WSS = water supply and sanitation.

Notes: [a] Marginal effects, [b] Incidence rate ratio, [c] Coefficients, [d] Merged age groups 11-17 and 18-24 to increase cell sample size, [e] Significance at 5% level, [f] Significance 1% level.

Source: Independent Evaluation Department estimates and Supplementary Appendix D.

4. Water Supply

23. Household members in the water supply project communities realized a 4% reduction in drudgery-related complains over non-project counterparts (Table A7.13). No significant education impact was found, but the labor force participation rate declined by 4.1% among 11–17 year olds, which may be associated with increased enrolment, particular of girls.

5. New Construction Subprojects

24. New construction subprojects did not have significant impact on the incidence or intensity of diarrhea reduction. However, the impact on drudgery reduction was significant, with 6.8% fewer household members in project areas experiencing drudgery-related problems. Education impact was contrary to expectation, as project construction led to a 5.3% reduction in enrolment by older children (18–24 years) over non-project areas. Similarly, enrolment was reduced by 18.3% among 11–17 year old males. The subprojects were, however, successful in reducing the number of households with children not going to school because of poor water supply and/or toilet facilities. The projects did not have any significant impact on labor activity.

6. Rehabilitation Subprojects

25. The study results show that neither the comparison of means and proportions, nor the multivariate analysis, indicated rehabilitation subprojects having significant health or labor supply impacts. In terms of education impact, enrolment by 6–10 year olds increased by 9.0% as a result of rehabilitation subprojects. The number of households with children not going to school for lack of clean water decreased by 1.9%. No other statistically significant impacts were found.

26. A comparative analysis of these results indicate that the earlier PRWSSP offered greater reduction in drudgery than did the later PCWSSP. This may reflect the more remote sites for PRWSSP subprojects. The impact on school attendance for all ages was positive for the PCWSSP and negative for the PRWSSP. The surprising negative result may reflect the high proportion of nonfunctional subprojects. However, the PRWSSP generated significant reductions in the proportion of households with children not going school for lack of water supply or toilet facilities, unlike the impact of the PCWSSP, which was insignificant. These estimates partly confirm the earlier results of the PRWSSP outperforming the PCWSSP in term of larger favorable impacts such as reducing drudgery and the proportion of households with children not attending school for lack of water or toilet facilities, but not in the case of school attendance. These results can be explained by the duration of the project.[18] The older PRWSSP is expected to have a larger favorable impact than the newer PCWSSP.

27. The results suggest that WSS subprojects had larger impacts on drudgery than did water supply ones. While the water supply subprojects had no significant impact on education, the WSS subprojects significantly reduced the proportion of children not going to school for lack of water and/or toilet facilities. Both water supply and WSS subprojects had significantly negative impact on labor force participation.

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[18] King and Berhman (King, E. and J. Berhman. 2009. Time and Duration of Exposure in Evaluation of Social Programs. *World Bank Research Observer*: forthcoming) have argued that timing and duration of exposure are important in impact evaluation. They argue that this is particularly important for “social programs that require changes in behavior of both service providers and service users in order to bring about measurable outcomes.” Many of the water and sanitation interventions clearly fall into this category.

28. Comparing the type of construction, new construction brought a significant reduction in drudgery but rehabilitation did not. School enrolment declined for 11–17 year olds in newly constructed water supply and WSS areas and increased among 6–10 year olds in rehabilitation areas. Both new and rehabilitated subprojects significantly reduced the proportion of households with children not going to school for lack of water facilities. The new construction subprojects significantly lowered the proportion of households with children not going to school for lack of toilet facilities. Construction type had no significant impact on either labor indicator.

ASSESSMENT OF WATER SUPPLY AND SANITATION INFRASTRUCTURE, SURROUNDING ENVIRONMENT, AND COMMUNITY-BASED ORGANIZATIONS

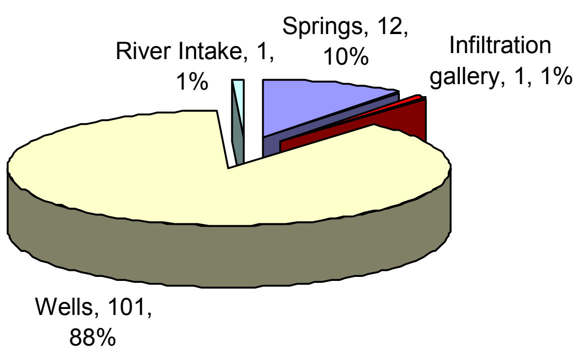
A. Technical Assessment of Subprojects

1. The technical assessment of subprojects covered water sources; functional status; water availability; uses of water provided through the system; system components; water quality and safety issues, including chemical analysis of water samples from the source and consumption points, sanitary hazards to water supply systems, and operation and maintenance (O&M); and system finance. In addition, the assessment sought local residents' collective perceptions about the performance of subprojects over time, water source protection measures and water quality, and understanding about hygiene and sanitation. The analysis is based on information gathered for the 115 subprojects selected for the study using the stratified random sampling method.[1]

1. Water Sources

2. Consistent with the hydrogeology and topography of the target areas covered by the sector projects, groundwater is the dominant water source, serving for 88% of the subprojects (Figure A8.1). This heavy reliance on groundwater necessitates huge dependence on pumping machinery, a higher degree of caretaking, and usually reliance on electricity. Since electricity supply has become increasingly erratic and costly, it is predictable that many installed water supply schemes face sustainability challenges. Springs serve as the next major source of water for installed sample subprojects (10%) and are particularly prevalent in Rawalpindi District. Only a handful of subprojects relied on river intake and infiltration gallery.

Figure A8.1: Source Types



Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

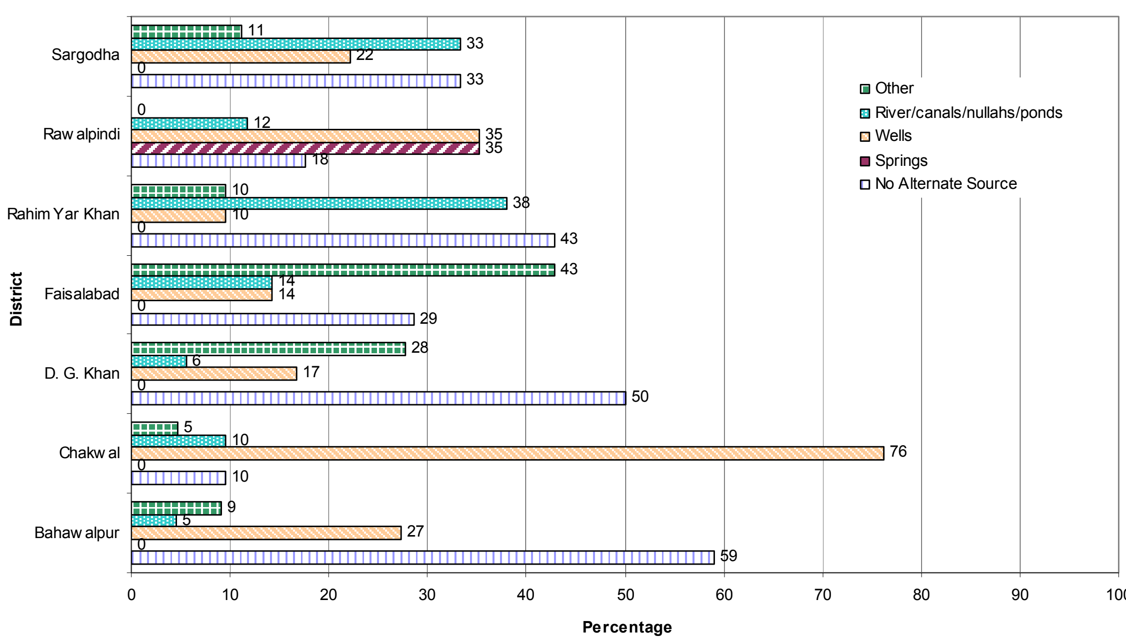
3. Tubewell subprojects dominate both the Punjab Rural Community Water Supply and Sanitation Project (PRWSSP), at 84%, and the Punjab Community Water Supply and Sanitation Project (PCWSSP), at 91%. The PRWSSP attempted to initiate subprojects using river intake

[1] Full methodology is discussed in Appendix 6, pages 60–71.

and infiltration galleries. The PCWSSP had proportionately more spring systems (16% versus 6%), which are prevalent in Chakwal and Rawalpindi districts.

4. The sustainability of water supply schemes depends on, among other factors, the availability of alternative sources of drinking water in a given community. The existence and type of alternative sources of water varied widely across the seven study districts (Figure A8.2). For example, 70% of the subproject communities had wells as alternative sources of drinking water. However, more than half of the communities in Dera Ghazi Khan and Bahawalpur districts had no alternative sources. One third of the communities in Sargodha District and 38% of the communities in Rahim Yar Khan District reported rivers, canal, and ponds as alternative sources of drinking water.

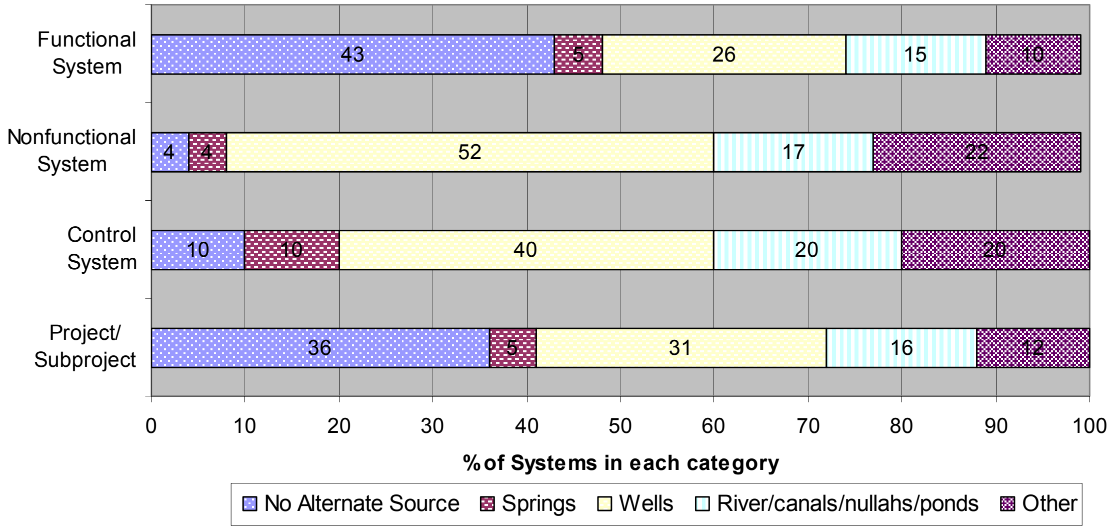
Figure A8.2: Alternate Source of Drinking Water for Survey District



Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

5. Communities' reliance on alternative sources of drinking water was correlated with the functional status of subprojects. The functional subprojects were in communities that tended to rely less on alternative water sources than did nonfunctional ones. More than two fifths (43%) of communities with functional systems had no alternative source, compared with only 4% of the nonfunctional ones. Proportionately, more water supply systems in project communities had functional systems than did control communities (Figure A8.3). Also, 34% of PRWSSP and 37% of PCWSSP communities had no alternative source of drinking water, while 36% of PRWSSP and 28% of PCWSSP communities reported wells as alternative sources. One in five PRWSSP communities relied on rivers, canals, and ponds, compared with one in eight PCWSSP. The southern districts of Bahawalpur, Rahim Yar Khan, and Dera Ghazi Khan exhibited fewer alternative sources than did their northern counterparts, Chakwal and Rawalpindi in particular.

Figure A8.3: Existence of Alternate Sources of Water and System Status



Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

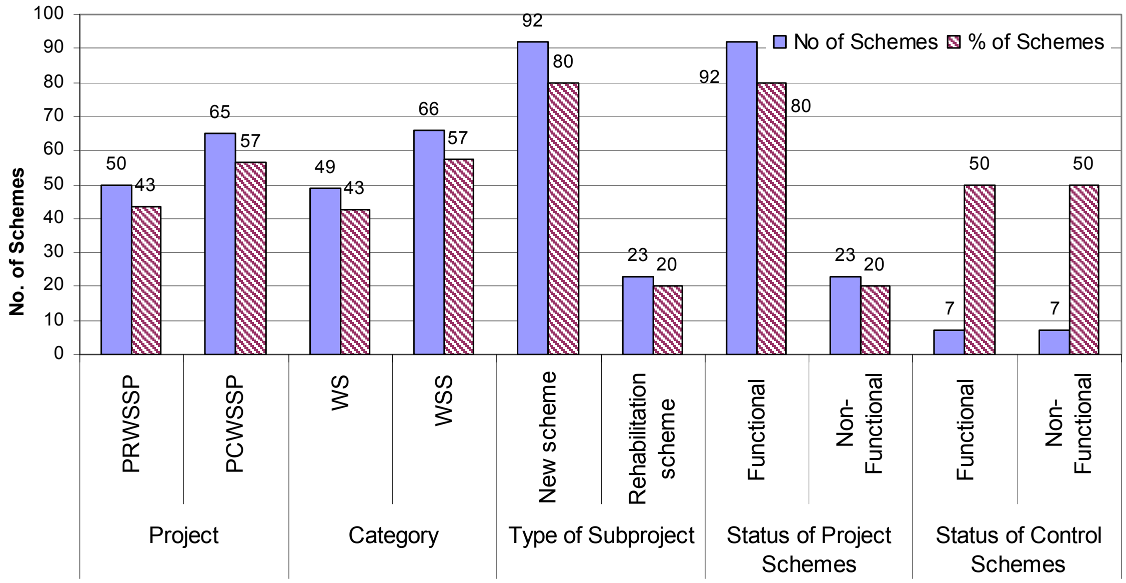
6. It was expected that residents of the communities with fewer alternative sources of drinking water would be more willing to pay for water than those in communities with varied options. One would also expect more willingness to pay for water in southern districts than in northern districts. Similarly, communities with fewer alternative options would have stronger commitment in keeping the water-supply system functional.

2. Functional Status

7. The distribution of the sample subprojects by type appears in Figure A8.4. The types include stage of the project (PRWSSP versus PCWSSP), type of intervention (water supply versus water supply and sanitation [WSS]), and nature of construction work (rehabilitated versus new construction). The sample proportionately represented population as 43% PRWSSP versus 57% PCWSSP, 43% water supply versus 57% WSS, 80% new construction versus 20% rehabilitated. Overall, 80% of the subprojects were found to be functional,[2] compared with only 50% of similar systems in non-project (control) communities.

[2] Functionality means that the system is able to provide water to the communities, though not necessarily 24 hours a day, 7 days a week.

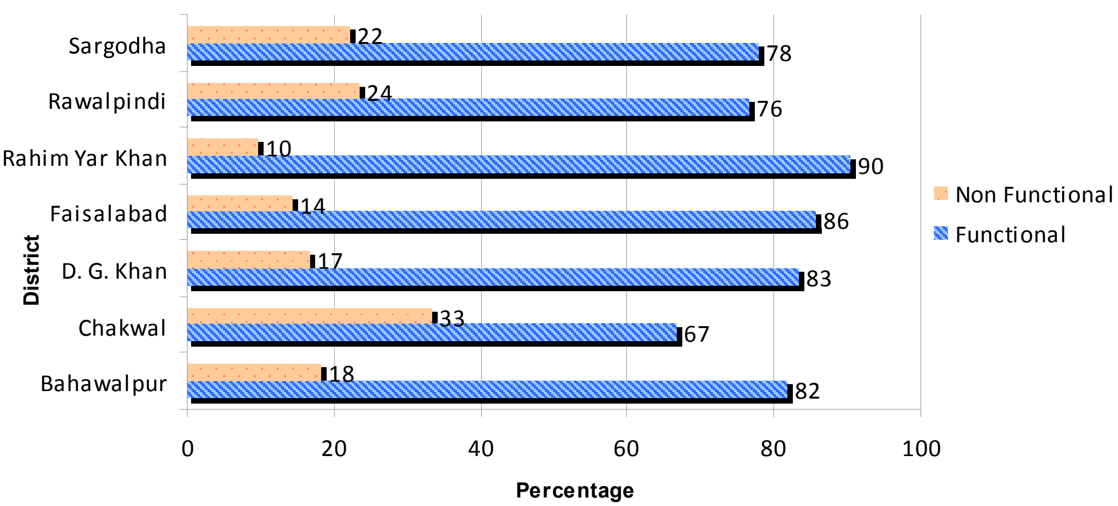
Figure A8.4: Distribution of Subprojects by Typology



No. = number, PCWSSP = Punjab Community Water Supply and Sanitation Project, PRWSSP = Punjab Rural Water Supply and Sanitation Project, WS = water supply, WSS = water supply and sanitation.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

8. At the project level, 89% of PCWSSP subprojects were found to be functional, compared with 68% of PRWSSP subprojects. Similarly, 83% of the gravity-based subprojects were functional, in contrast to 77% of the pump-based subprojects. Rahim Yar Khan District had the highest percentage of functional subprojects (90%), followed by Faisalabad (86%), Dera Ghazi Khan (83%), and Bahawalpur (82%) (Figure A8.5). Chakwal and Rawalpindi had the bulk of the nonfunctional subprojects, most of which were PRWSSP subprojects.

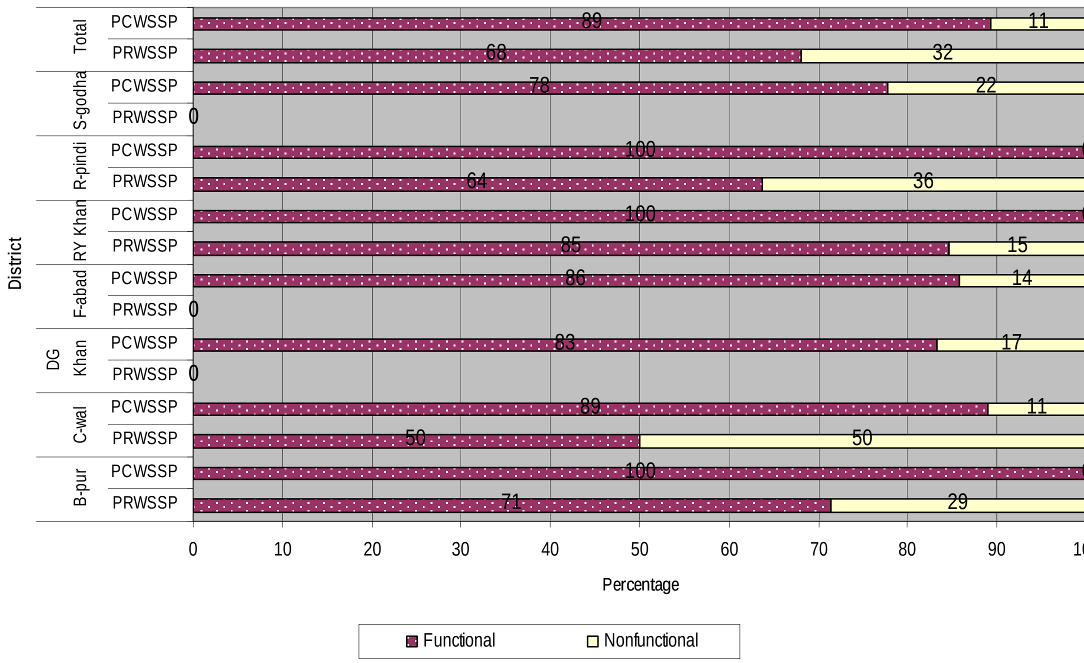
Figure A8.5: Percentage of Functional and Nonfunctional Subprojects in Study Districts



Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

9. All PCWSSP subprojects in Rawalpindi, Rahim Yar Khan, and Bahawalpur were functional (Figure A8.6). On the other hand, half of the PRWSSP subprojects in Chakwal District were nonfunctional. While 23 of the 115 subprojects were found to be nonfunctional, nearly two thirds (15) were new WSS construction subprojects under the PRWSSP.

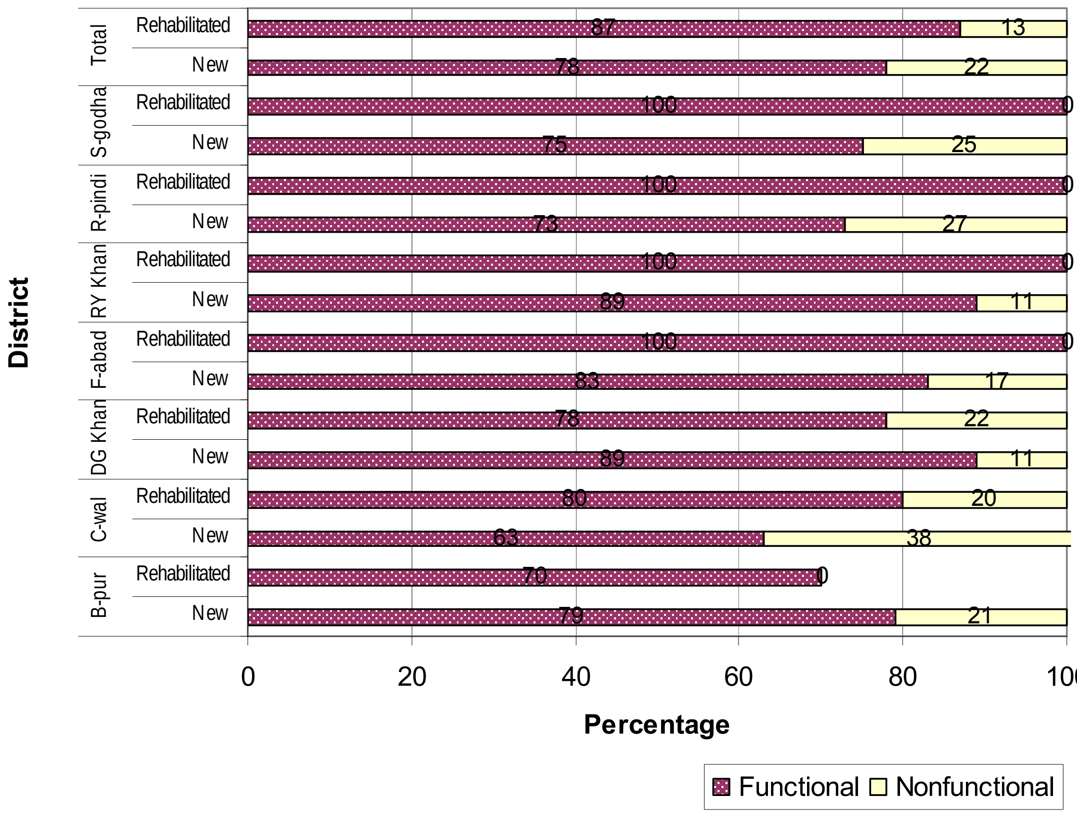
Figure A8.6: Functional Status of Subproject
(by project)



B-pur = Bahawalpur, C-wal = Chakwal, DG Khan = Dera Ghazi Khan, F-abad = Faisalabad, PCWSSP = Punjab Community Water Supply and Sanitation Project, PRWSSP = Punjab Rural Water Supply and Sanitation Project, RY Khan = Rahim Yar Khan, R-pindi = Rawalpindi, S-godha = Sargodha.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

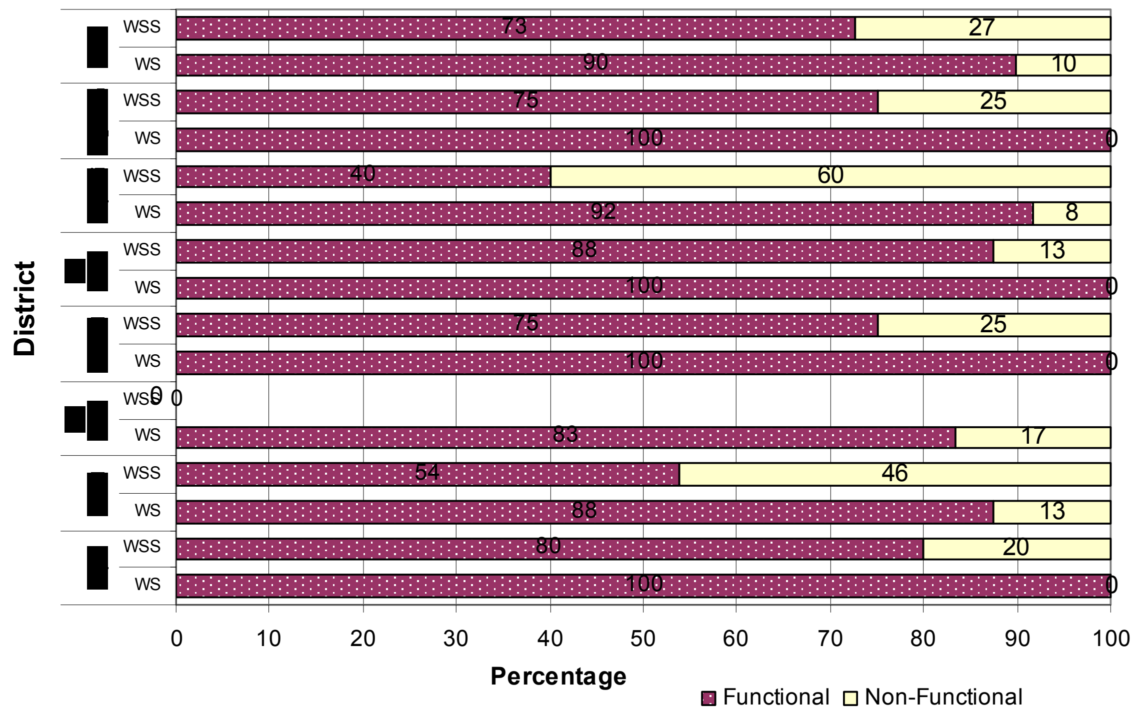
10. Nonfunctional subprojects comprised 22% of new construction subprojects and 13% of rehabilitation subprojects. Five of the seven study districts reported that all rehabilitation subprojects were functional (Figure A8.7). Similarly, Rahim Yar Khan and Dera Ghazi Khan reported 89% of new subprojects to be functional. Figure A8.7 shows that 73% of WSS and 90% of water supply subprojects were functional. All water supply subprojects were functional in four of the seven districts (Sargodha, Rahim Yar Khan, Faisalabad and Bahawalpur) (Figure A8.8). On the other hand, 60% of WSS subprojects were nonfunctional in Rawalpindi, as were 46% in Chakwal.

Figure A8.7: Functional Status of Subproject
(by type of construction)



B-pur = Bahawalpur, C-wal = Chakwal, DG Khan = Dera Ghazi Khan, F-abad = Faisalabad, RY Khan = Rahim Yar Khan, R-pindi = Rawalpindi, S-godha = Sargodha.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

Figure A8.8: Functional Status of Subproject
(by type of intervention by district)



B-pur = Bahawalpur, C-wal = Chakwal, DG Khan = Dera Ghazi Khan, F-abad = Faisalabad, RY Khan = Rahim Yar Khan, R-pindi = Rawalpindi, S-godha = Sargodha, WS = water supply, WSS = water supply and sanitation.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

3. Water Availability

11. The reliability of a water supply system is an important factor influencing the sustainability of a rural WSS subproject. Unreliable supply weakens individual commitment to maintaining the system and leads to dissatisfaction, which ultimately forces communities to rely on alternative sources of water, poor willingness to pay, and poor cost recovery. Three fourths of the subprojects performed to the benchmark or a higher standard in the dry season.[3] The corresponding figures were 71% for PRWSSP and 79% for PCWSSP subprojects (Figure A8.9). Similarly, during the wet season, performance was found to be 82% (78% for the PRWSSP and 84% for the PCWSSP). There was no significant difference in water availability performance reported by type of construction (new versus rehabilitation), and both types performed more or less equally well. Similarly, both water supply and WSS subprojects reported similar water availability.[4] However, more PCWSSP subprojects had close-to-ideal performance in water availability.

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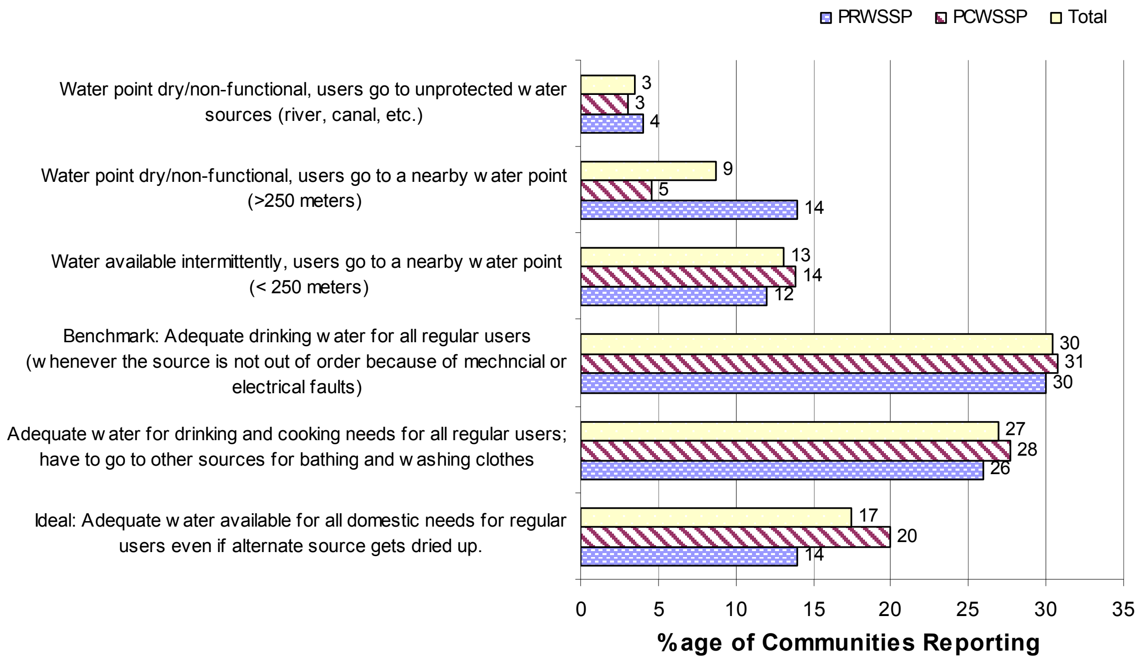
[3] The benchmark was adequate drinking water for all regular users when the supply was not out of order due to technical or electric faults.
[4] As there are no significant differences, data are not presented for new versus rehabilitated or water supply versus WSS.

Figure A8.9: Availability of Water from the Source-Dry Period
(n = 50 for phase I; n = 65 for phase II)



> = greater than, < = less than, % = percentage, PCWSSP = Punjab Community Water Supply and Sanitation Project, PRWSSP = Punjab Rural Water Supply and Sanitation Project.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

12. The availability of water varied significantly across the seven study districts, during both the dry and the wet season (Tables A8.1 and A8.2). More than four fifths of the subprojects in Bahawalpur, Faisalabad, and Rahim Yar Khan reported water availability from the systems at or above the benchmark in dry season. Rawalpindi, Chakwal, and Sargodha lagged far behind, with less than 70% of subprojects meeting the benchmark. Similarly, in the wet season, five of the seven districts performed at or above the benchmark, excluding Rawalpindi and Sargodha. Dera Ghazi Khan was the best performer in water supply, reporting 94% of subprojects meeting the benchmark standard or above.

Table A8.1: Water Supply from Source during Wet Period by Districts

District	1 Bad: Water point dry/nonfunctional, users go to unprotected sources (river, canal, etc.)		2 Water point dry/nonfunctional, users go to a nearby water points		3 Water available intermittently, users go to another near by water point		4 Benchmark: Safe & adequate amount of water available through wet period for basic domestic needs for regular users; other sources may be available for bathing/washing		5 In addition, adequate and safe water available for all throughout domestic needs, for regular users		6 I deal: In addition, capacity available for outside beneficiaries as well even if other sources become unusable for any reason (e.g. get polluted/flooded/low supply etc)		Total number of schemes	Cumulative responses for benchmark and above (Col 4 + Col 5 + Col 6)
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
Bahawalpur	0	0	2	9	1	`	6	27	10	45	3	14	22	86.4
Chakwal	2	10	2	10	0	0	8	38	7	33	2	10	21	81.0
DG Khan	0	0	1	6	0	0	3	17	11	61	3	17	18	94.4
Faisalabad	1	14	0	0	0	0	3	43	3	43	0	0	7	85.7
RY Khan	0	0	2	10	1	5	3	14	13	62	2	10	21	85.7
Rawalpindi	0	0	3	18	2	12	3	18	4	24	5	29	17	70.6
Sargodha	1	11	1	11	1	11	3	33	3	33	0	0	9	66.7
Total	4	3	11	10	5	4	29	25	51	44	15	13	115	82.6

% = percentage, Col = column, DG Khan = Dera Ghazi Khan, No. = number, RY Khan = Rahim Yar Khan.

Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

Table A8.2: Water at Source during Dry Period, by District

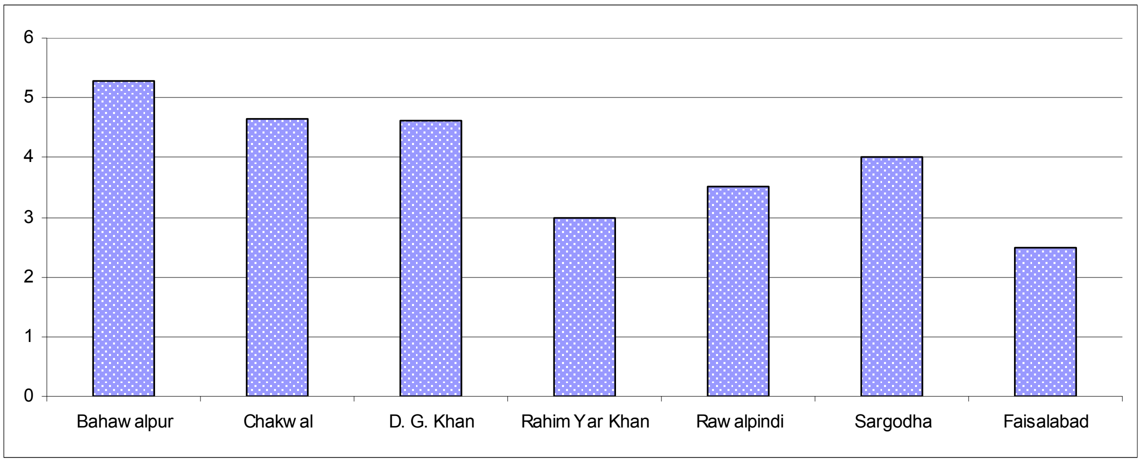
District	1 Bad: Water point dry/nonfunctional, users go to unprotected source (river, canal, etc.)		2 Water point dry/nonfunctional, users go to a nearby point (>250 meters)		3 Water available intermittently, users go to a nearby point (< 250 meters)		4 Benchmark: Adequate drinking water for all regular users (whenever the source is not out of order because of mechanical/electric faults)		5 Adequate water for drinking and cooking needs for all regular users; have to go to other sources for bathing/washing		6 Ideal: Adequate water available for all domestic needs for regular users even if alternate source dry.		Total schemes in the district	Cumulative responses for benchmark and above (%)
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%		
B-pur	0	0	2	9	1	5	7	32	7	32	5	23	22	86
C-wal	2	10	1	5	5	24	8	38	4	19	1	5	21	62
DG Khan	0	0	2	11	2	11	3	17	8	44	3	17	18	78
F-abad	1	14	0	0	0	0	5	71	1	14	0	0	7	86
RY Khan	0	0	2	10	1	5	4	19	7	33	7	33	21	86
R-pindi	0	0	2	12	5	29	4	24	2	12	4	24	17	59
S-godha	1	11	1	11	1	11	4	44	2	22	0	0	9	67
Total	4	3	10	9	15	13	35	30	31	27	20	17	115	75

% = percentage, B-pur = Bahawalpur, C-wal = Chakwal, DG Khan = Dera Ghazi Khan, F-abad = Faisalabad, No. = number, RY Khan = Rahim Yar Khan, R-pindi = Rawalpindi, S-godha = Sargodha.

Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

13. The analysis of 92 functional subprojects in terms of hours of water supply suggested that the PRWSSP subprojects provided water for longer (4.96 hours versus 4.85 hours). However, none of the communities reported a 24-hour, 7-days water supply, with all schemes providing water intermittently. Results indicated wide variation across the seven districts, ranging from less than 3 hours per day in Faisalabad to more than 5 hours per day in Bahawalpur (Figure A8.10).

Figure A8.10: Average Daily Water Supply by Subprojects
(by district)



Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

14. Overall, 59% of the households in PRWSSP areas and half of the households in PCWSSP areas acquired household connections for water supply. However, only 57% of households connected to water supply under the PRWSSP and 89% under the PCWSSP actually received water from the subprojects at the time of the interview. The results indicated that 14% of PCWSSP households used suction pumps to access water, compared with only 4% of the households under PRWSSP subprojects. District-level differentiation appears in Table A8.3. Likewise, 55% of the households in water supply subproject communities had connections, and 71% of those with connections actually received water. Further, 49% households in WSS communities had water supply connections, of which 89% actually received water at the time of the interview. Probably because of its difficult terrain, Chakwal District did not perform well and had the lowest percentage of connected households receiving water under both projects. The results suggest that the southern districts had higher connection rates and water availability through piped connections. This may had been driven by the lack of alternative water sources.

Table A8.3: Households Connected, Receiving Water and Using Suction Pumps
(by project)

	PRWSSP			PCWSSP		
Districts	**HH connected** (%)	**Connected household receiving water** (%)	**HH using suction machines when pressure is low** (%)	**HH connected** (%)	**Connected household receiving water** (%)	**HH using suction machines when pressure is low** (%)
Bahawalpur	63	78	17	59	107	6
Chakwal	50	36	0	69	80	0
Dera Ghazi Khan				45	85	43
Rahim Yar Khan				58	96	34
Rawalpindi	66	76	7	78	99	8
Sargodha	68	59	0	42	85	1
Faisalabad				32	84	4
Total	**59**	**57**	**4**	**50**	**89**	**14**

HH = households, PCWSSP = Punjab Community Water Supply and Sanitation Sector Project, PRWSSP = Punjab Rural Water Supply and Sanitation Sector Project.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

15. Interestingly, 18% of households with connections to water supply under water-supply subprojects used suction pumps to extract water, compared with only 4% of households connected to water supply in WSS communities (Table A8.4). According to the respondents, low water pressure was the most important reason for opting to install suction pumps. Low water pressure meant suction pumps were more prevalent in rehabilitation subprojects (39%) than in new construction (6%). Half of the households with water supply connections in Rahim Yar Khan, and 62% of those in Dera Ghazi Khan, reported using suction pumps, followed by 26% of households in Rawalpindi.

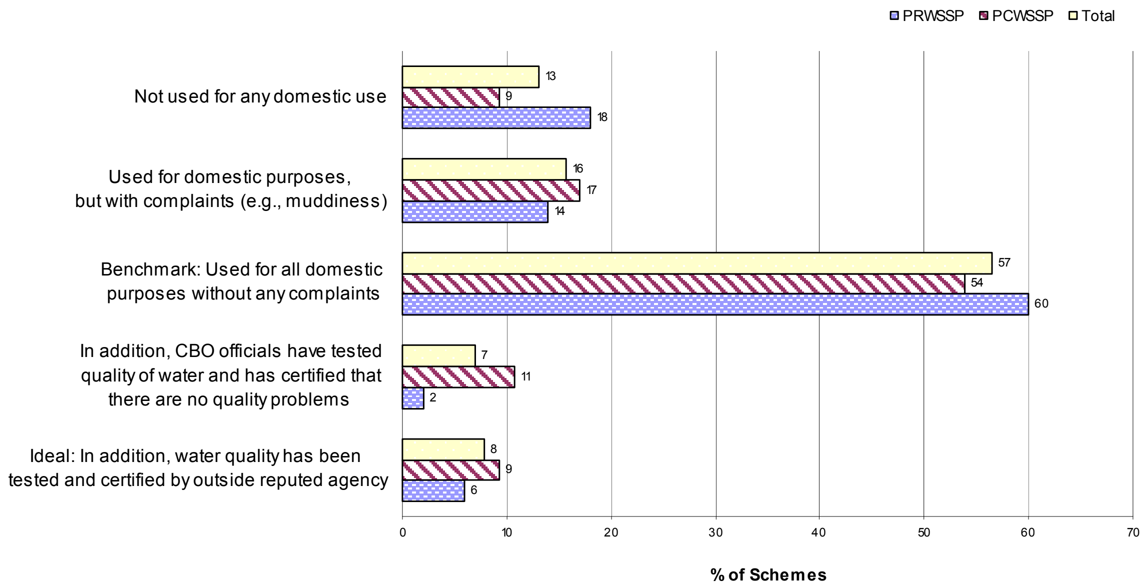
Table A8.4: Details of HH Connected, Receiving Water and Use of Suction Pumps
(type of project)

	Water Supply			Water Supply and Sanitation		
District	**HH Connected** (%)	**Connected household receiving water** (%)	**HH using suction machines when pressure is low** (%)	**HH Connected** (%)	**Connected household receiving water** (%)	**HH using suction machines when pressure is low** (%)
Bahawalpur	58	85	21	74	115	11
Chakwal	55	44	0	61	86	0
Dera Ghazi Khan	48	100	43	43	75	
Rahim Yar Khan	51	95	47	90	100	14
Rawalpindi	68	82	12	89	100	6
Sargodha	69	63	0	25	100	0
Faisalabad	32	82	0	38	100	5
Total	**55**	**71**	**18**	**49**	**89**	**5**

HH = households.
Source: Independent Evaluation Department. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

4. Water Uses

Figure A8.11: Uses of Water Supplied by the Subprojects



CBO = community-based organization, PCWSSP = Punjab Community Water Supply and Sanitation Project, PRWSSP = Punjab Rural Water Supply and Sanitation Project.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

16. The benchmark for water uses was that households availing themselves of water from subprojects could use the water for all domestic purposes without any complaint, with 72% of subprojects meeting that benchmark or better. However, 16% of subprojects encountered complaints, such as muddy water at times. The results did not demonstrate any significant aggregate variation between the PRWSSP and the PCWSSP (Figure A8.11). Overall water use was fairly high, demonstrating communities' heavy reliance on the subprojects.

5. System Components

17. To better understand the most common technical problems affecting the schemes' performance and sustainability, the study enquired about issues regarding (i) intake structures, (ii) treatment units, (iii) storage facilities, (iv) transmission systems (supply and delivery mains), (v) pumping systems, and (vi) distribution networks. PCWSSP subprojects had fewer technical issues than PRWSSP subprojects. Similarly, nonfunctional schemes faced more than twice as many technical issues than functional schemes in most technical areas. The five most common problems affecting schemes' performance were, in decreasing order of frequency, (i) the lack of alternative pumping machinery, (ii) chlorination system issues, (iii) broken or leaky valves, (iv) broken or leaking pipes, (v) low pressure areas, (vi) issues with components such as appurtenances and joints, and (vii) damage from external causes.

18. The study analyzed the reasons why subprojects were nonfunctional and noted that the most common technical issues were generic: (in descending order) (i) component problems (appurtenances or joints problems); (ii) damage from external causes; (iii) broken or leaking pipes; (iv) broken or leaky valves; (v) lack of alternative pumping machinery; (vi) lack of safety

measures such as voltage regulators; and (vii) disputes (Figure A8.13). Issues facing new and rehabilitation subprojects are summarized in Figure A8.13, and those facing water supply and WSS subprojects appear in Figure A8.14.

6. Quality of Water at the Source and Consumption Points

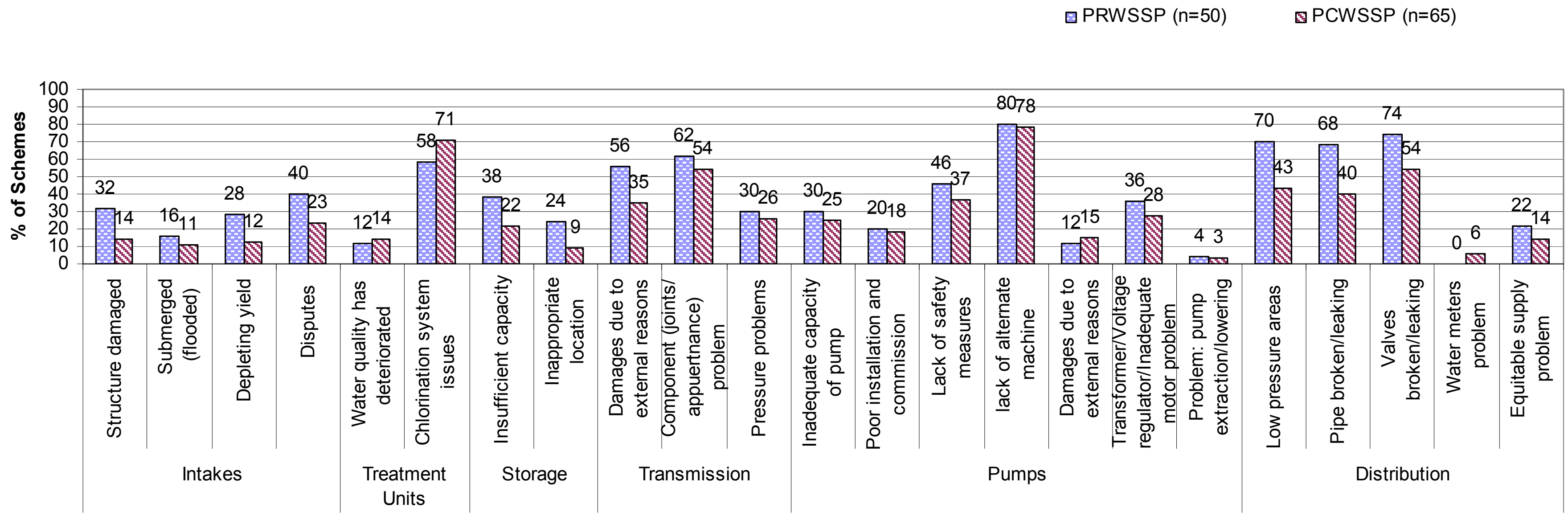
19. Arsenic testing of drinking water supplies across the country had previously indicated that Liyah, Multan, Bahawalpur, Rahim Yar Khan, and Dera Ghazi Khan were high-risk districts, with several areas indicating arsenic levels at over 50 parts per billion. Other problems related to nitrate and fluoride contamination of more than 10 parts per billion occurred in several districts, including Chakwal, Faisalabad, and Bahawalpur.[5] With this background, water samples from subproject and control villages were tested for bacteriological and chemical quality. Only fluoride levels in one scheme in Rahim Yar Khan and two schemes in Bahawalpur were found to be above the World Health Organization standard. Two schemes in Dera Ghazi Khan, four in Rahim Yar Khan, and four in Bahawalpur were found to have high values for fluoride but within the range. In addition, fluoride turbidity was found high in 3 of the 115 sample subprojects and was recorded above the World Health Organization standards of 5 nephelometric turbidity units. None of the 115 subprojects had arsenic above the tolerance level.

20. For functional subprojects, the study team collected aseptic samples for laboratory testing using standard sampling procedures. Samples were drawn from the water source and distribution points such as household connections and community tanks and standposts. The water samples were tested for bacteriological pollution using a Del Agua field water quality testing kit.[6]

[5] Akram K., T. Aslam, and R. Hifza. 2005. *Water Quality Report*. Islamabad: Pakistan Council for Research in Water Resources.

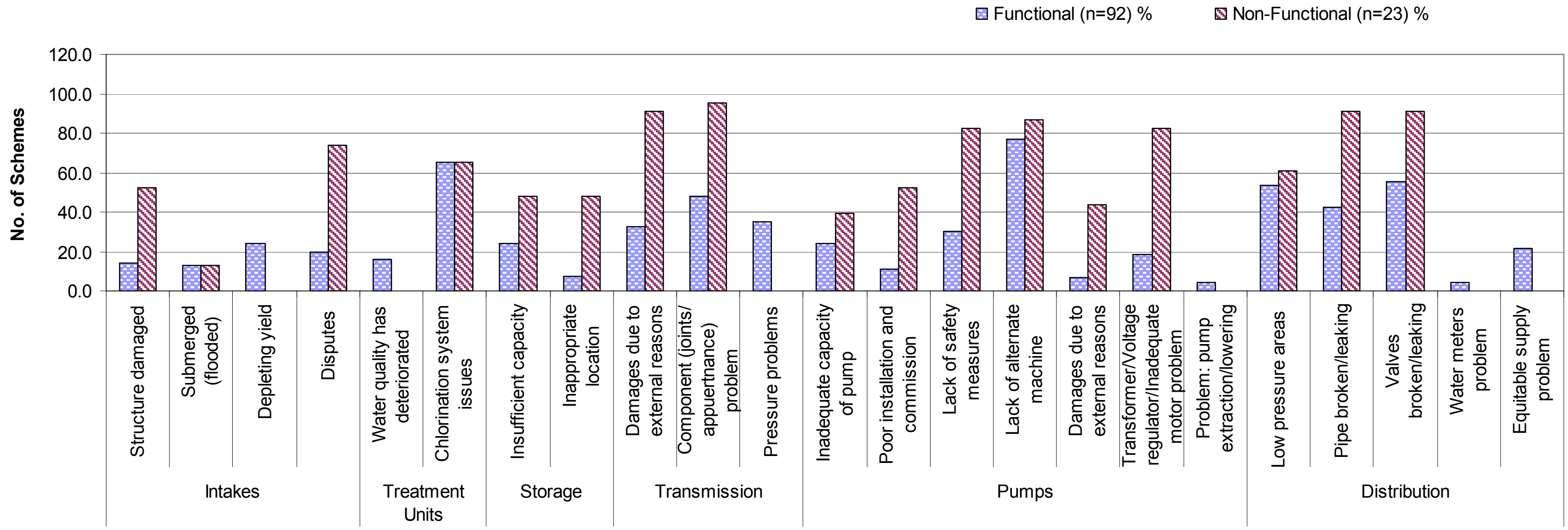
[6] The Del Agua field water quality testing kit is a mobile kit manufactured by Robins Centre of Sussex University in the United Kingdom and used globally to test water quality, especially during emergencies.

Figure A8.12: Quality of Works: Impact on Schemes Sustainability
(by project)



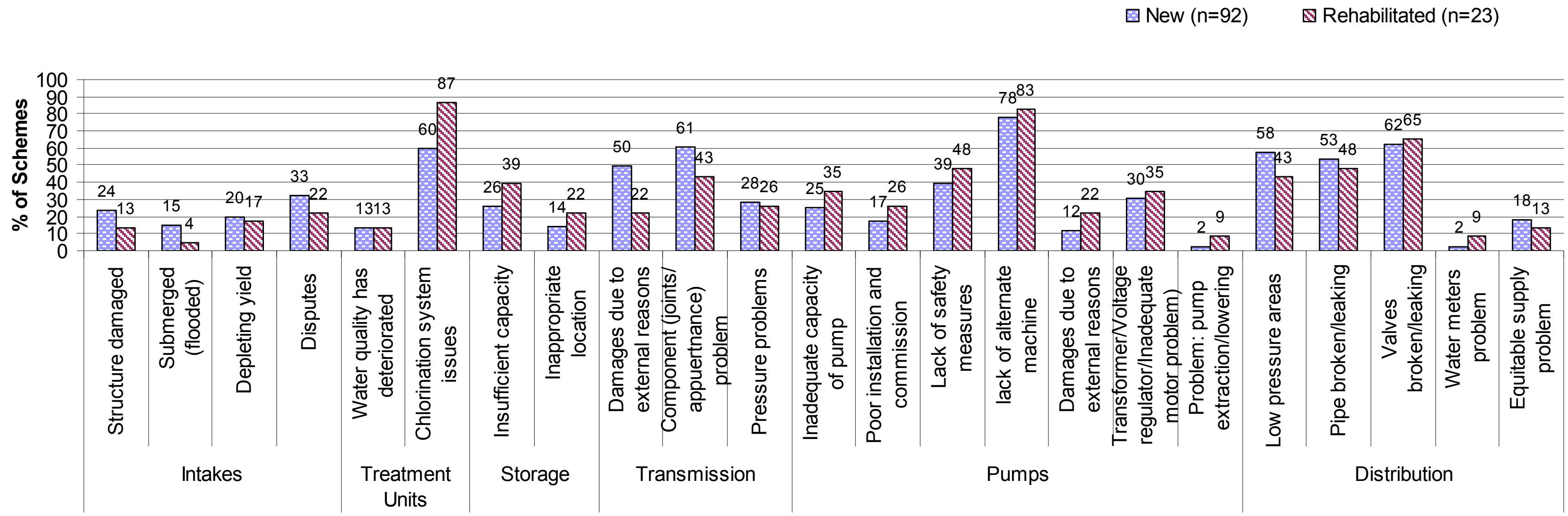
n = number, PCWSSP = Punjab Community Water Supply and Sanitation Project, PRWSSP = Punjab Rural Water Supply and Sanitation Project.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

Figure A8.13: Quality of Work: Impact on Schemes Sustainability
(by functional and nonfunctional schemes)



n = number, PCWSSP = Punjab Community Water Supply and Sanitation Project, PRWSSP = Punjab Rural Water Supply and Sanitation Project.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

Figure A8.14: Quality of Work: Impact on Subproject Sustainability
(by type of construction)



n = number.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

21. Laboratory testing found 45% of the samples from the source (n=96)[7] and 72% of samples from the distribution network had bacteriological pollution. The results for the non-subproject areas turned out to be much worse (71% bacteriological pollution at the source and 100% at the distribution point). The test results did not demonstrate any statistical difference in the bacteriological quality of water in PRWSSP and PCWSSP subprojects (Table A8.5). However, water quality turned out to be better in WSS subprojects than in water supply subprojects. Bacteriological contamination at the water source was found in 35% of the WSS subprojects, compared with 55% of the water supply subprojects. Similarly, contamination at the distribution point was 65% for the WSS subprojects, compared with 79% for water supply subprojects.

Table A8.5: Bacteriological Quality of Water at the Source and at the Distribution Point

Bacteriological Quality	Project				Category				Total		Control Schemes	
	PRWSSP		PCWSSP		WS		WSS					
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
A. Source												
Un-Polluted	19	53	34	57	21	45	32	65	53	55	2	29
Polluted	17	47	26	43	26	55	17	35	43	45	5	71
Total	**36**	**100**	**60**	**100**	**47**	**100**	**49**	**100**	**96**	**100**	7	**100**
B. Distribution Point												
Un-Polluted	9	25	18	30	10	21	17	35	27	28	0	**0**
Polluted	27	75	42	70	37	79	32	65	69	72	7	**100**
Total	**36**	**100**	**60**	**100**	**47**	**100**	**49**	**100**	**96**	**100**	7	**100**

No. number, PCWSSP = Punjab Community Water Supply and Sanitation Project, PRWSSP = Punjab Rural Water Supply and Sanitation Project, WS = water supply, WSS = water supply and sanitation.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

22. Table A8.6 shows the bacteriological quality of drinking water at the source and distribution points by district. For WSS subprojects, none of the source or distribution point water samples from Faisalabad and Dera Ghazi Khan had bacteriological pollution. On the other hand, Rawalpindi had very high level bacteriological pollution at both the source and distribution points. While Sargodha had high bacteriological pollution at both the source and distribution points (85% and 71%, respectively), Bahawalpur had relatively low pollution at the source but high pollution at distribution points (31% and 94%, respectively). Similarly, test results for water samples from water supply subprojects found Faisalabad the best performing district, and Rawalpindi and Sargodha the worst. Bacteriological pollution at the distribution point was significantly higher in Bahawalpur (89%), followed by Chakwal and Dera Ghazi Khan (73%).

[7] A number higher than the 92 functional schemes, as some have more than one source.

Table A8.6: District Wise Bacteriological Quality of Drinking Water

Bacteriological Quality	B-pur		C-wal		DG Khan		Faisalabad		RY Khan		R-pindi		Sargodha		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
WSS Schemes																
A. Source																
Un-Polluted	11	69	5	50	0	0	6	100	13	93	0	0	1	14	36	65
Polluted	5	31	5	50	0	0	0	0	1	7	2	100	6	86	19	35
Total	16	100	10	100	0	0	6	100	14	100	2	100	7	100	55	100
B. Distribution Point																
Un-Polluted	1	6	4	40	0	0	3	50	8	57	0	0	2	29	18	33
Polluted	15	94	6	60	0	0	0	0	6	43	2	100	5	71	34	62
Total	16	100	10	100	0	0	3	50	14	100	2	100	7	100	52	95
WS Schemes																
A. Source																
Un-Polluted	13	72	6	40	9	60	6	100	17	89	1	7	1	13	**53**	**55**
Polluted	5	28	9	60	6	40	0	0	2	11	14	93	7	88	**43**	**45**
Total	18	100	15	100	15	100	6	100	19	100	15	100	8	100	**96**	**100**
B. Distribution Point																
Un-Polluted	2	11	4	27	4	27	6	100	12	63	0	0	2	25	**30**	**31**
Polluted	16	89	11	73	11	73	0	0	7	37	15	100	6	75	**66**	**69**
Total	**18**	**100**	**15**	**100**	**15**	**100**	**6**	**100**	**19**	**100**	**15**	**100**	**8**	**100**	**96**	**100**

B-pur = Bahawalpur, C-wal = Chakwal, DG Khan = Dera Ghazi Khan, No. = number, RY Khan = Rahim Yar Khan, R-pindi = Rawalpindi, WS = water supply, WSS = water supply and sanitation.
Source: Independent Evaluation Department. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

7. Sanitary Hazard Assessment

23. As the quality of water varies over time, it is important that the vulnerability of a particular system to a sanitary and pollution hazard be known. The greater the hazard, the more vulnerable the system is to pollution in the future. Hence, in addition to the laboratory tests of water samples from the source and distribution points, the study conducted sanitary inspections[8] of sample subprojects at water sources and key distribution points (e.g., water tanks and storage reservoirs, where present) to provide a comprehensive technical assessment of the subprojects examined. The inspections covered such water sources as springs, tubewells, and shallow wells. Exposure to a sanitary hazard was recorded on a scale of 1 to 10.[9]

24. The assessment found 82% of the spring sources and 53% of shallow well sources were either highly or very highly hazardous, compared with 32% of tubewells (Table A8.7). The tubewells were less vulnerable to sanitary hazards because water is normally drawn from deeper aquifers. Also, PRWSSP subprojects were found to be prone to sanitary hazards, as 59% posed high or very high sanitary hazards, compared with 34% of subprojects under the PCWSSP. This partly reflected proportionately higher representation of gravity-based water supply systems in the PRWSSP than the PCWSSP. However, only 30% of rehabilitation subprojects posed high or very high sanitary hazards, in contrast to 48% of the newly constructed subprojects. These findings are consistent with laboratory water quality test results

[8] Sanitary Inspection helps to identify and prioritize sanitary hazards and suggest mitigation measures. The study used checklists provided in the World Health Organization Drinking Water Quality Guidelines V3.
[9] A score of 1 is lowest hazard, 10 is highest.

that the subprojects under ADB assistance have better water quality, with low bacteriological pollution and sanitary hazard risk.

Table A8.7: Vulnerability to Sanitary Hazards

Item	Contamination Risk									
	Low		Intermediate		High		Very High		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
A. Type of Water Source										
Springs	0	0	2	18	8	73	1	9	**11**	**100**
Tube wells	10	14	39	54	22	31	1	1	**72**	**100**
Shallow wells	1	5	8	42	10	53	0	0	**19**	**100**
Total	**11**	**11**	**49**	**48**	**40**	**39**	**2**	**2**	**102**	**100**
B. Type of Scheme										
New	6	8	33	45	33	45	2	3	**74**	**100**
Rehabilitated	4	20	10	50	6	30	0	0	**20**	**100**
Total	**10**	**11**	**43**	**46**	**39**	**41**	**2**	**2**	**94**	**100**
C. Project/Phase										
PRWSSP	1	3	14	39	19	53	2	6	**36**	**100**
PCWSSP	9	16	29	50	20	34	0	0	**58**	**100**
Total	**10**	**11**	**43**	**46**	**39**	**41**	**2**	**2**	**94**	**100**

No. = number, PCWSSP = Punjab Community Water Supply and Sanitation Project, PRWSSP = Punjab Rural Water Supply and Sanitation Project.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

25. A comparison of sanitary hazard scores by district is presented in Table A8.8. At least half of the subprojects are classified as posing high or very high risk. Dera Ghazi Khan and Bahawalpur were the best performing districts, while Rawalpindi and Rahim Yar Khan were the worst among the seven districts examined.

Table A8.8: Sanitary Hazard Score in Study Districts

District	Contamination Risk											
	Low		Intermediate		High		Very High		Total		High + Very High %	District Ranking
	No.	%	No.	%	No.	%	No.	%	No.	%		
Bahawalpur	1	6	13	76	3	18	0	0	17	100	18	6
Chakwal	2	12	5	29	9	53	1	6	17	100	59	3
D. G. Khan	4	27	10	67	1	7	0	0	15	100	7	7
Faisalabad	1	17	2	33	3	50	0	0	6	100	50	4
R. Y. Khan	1	5	6	32	12	63	0	0	19	100	63	2
Rawalpindi	0	0	4	31	8	62	1	8	13	100	69	1
Sargodha	1	14	3	43	3	43	0	0	7	100	43	5
Total	10	11	43	46	39	41	2	2	94	100	44	

No. = number.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

26. The sanitary hazards associated with community tanks, dug wells, springs, and tubewells appear in Tables A8.9 to A8.12. The most common sanitary risks associated with community tanks and reservoirs included (i) the presence of other sources of pollution around

the community tank other than human and animal excreta; (ii) no disinfection of tanks undertaken; (iii) an unfenced and unprotected area around the tank; and (iv) unsanitary valve chamber covers. The most potent sanitary risk was from unsanitary valve chambers. These chambers most often collect filth, rain, and wastewater. During hours of no supply, polluted water is sucked in and, when supplies resume, the entire supply of water is contaminated. Likewise, the most sanitary risks associated with dug wells were (i) no regular disinfection practices carried out; (ii) a concrete floor less than 1 meter wide around the parapet wall; (iii) a source of pollution (e.g., animal excreta, rubbish, or surface water within 10 meters of the borehole, and (iv) no fencing. None of the sanitary hazards required costly mitigation measures, so with little investment wells can be protected to ensure the delivery of safe water at all times.

Table A8.9: Districts Sanitary Hazards
(community tanks)

	B-Pur (n = 10)		C-wal (n = 2)		DG Khan (n = 3)		F-abad (n = 4)		RY Khan (n = 6)		R-pindi (n = 7)		S-godha (n = 2)		Total (n = 34)	
Information	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Presence of solid waste and animal excreta	10	100	2	100	3	100	4	100	5	83	7	100	2	100	33	97
Tank not disinfected	8	80	2	100	3	100	3	75	6	100	7	100	2	100	31	91
Area around the tank unfenced or unprotected	10	100	1	50	3	100	4	100	5	83	4	57	2	100	29	85
Valve chamber covers unsanitary	10	100	2	100	2	67	4	100	4	67	6	86	0	0	28	82
Water accumulate near the taps/tank	8	80	1	50	3	100	2	50	5	83	4	57	0	0	23	68
Human excreta within 10 m of the tank/taps	5	50	1	50	2	67	3	75	3	50	5	71	1	50	20	59
Point of leakage between source and reservoir	5	50	2	100	1	33	2	50	4	67	5	71	0	0	19	56
Plinth cracked or eroded	6	60	0	0	1	33	2	50	3	50	0	0	1	50	13	38
Inspection cover of the tank unsanitary	3	30	1	50	0	0	1	25	2	33	5	71	0	0	12	35
Air vents unsanitary	2	20	1	50	0	0	1	25	1	17	6	86	0	0	11	32
Pollutants inside the tank	1	10	1	50	0	0	0	0	1	17	7	100	0	0	10	29
Reservoir cracked or leaks	1	10	0	0	2	67	1	25	0	0	0	0	0	0	4	12

B-pur = Bahawalpur, C-wal = Chakwal, F-abad = Faisalabad, DG Khan = Dera Ghazi Khan, No. = number, RY Khan = Rahim Yar Khan, R-pindi = Rawalpindi, S-godha = Sargodha.
Note: n = number of schemes with community tank facilities; n = 34.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

Table A8.10: Sanitary Hazards-Dug Wells Districts
(yes response)

Information	B-Pur (n = 0)		C-wal (n = 15)		DG Khan (n = 0)		F-abad (n = 1)		RY Khan (n = 0)		R-pindi (n = 3)		S-godha (n = 0)		Total (n = 0)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
No disinfection practices are carried out regularly	0	0	15	100	0	0	1	100	0	0	2	67	0	0	18	100
Concrete floor less than I m wide around the parapet wall	0	0	13	87	0	0	1	100	0	0	3	100	0	0	17	94
Other source of pollution (e.g., animal excreta rubbish Surface water) within 10 m of the borehole	0	0	12	80	0	0	1	100	0	0	3	100	0	0	16	89
Installation requires fencing.	0	0	12	80	0	0	1	100	0	0	3	100	0	0	16	89
Parapet wall around the well inadequate allowing surface water to enter the wall	0	0	11	73	0	0	1	100	0	0	2	67	0	0	14	78
Lining of the well inadequately sealed at any point for 3 m below the ground	0	0	11	73	0	0	0	0	0	0	1	33	0	0	12	67
Rope and bucket are used; are these left in such a position that they may become contaminated	0	0	3	20	0	0	0	0	0	0	1	33	0	0	4	22
Latrine within 15–20 m of the pump house that percolates into the soil, i.e., unsewered	0	0	1	7	0	0	1	100	0	0	0	0	0	0	2	11
Nearest latrine on higher ground than the well	0	0	1	7	0	0	0	0	0	0	0	0	0	0	1	6

B-pur = Bahawalpur, C-wal = Chakwal, F-abad = Faisalabad, DG Khan = Dera Ghazi Khan, No. = number, RY Khan = Rahim Yar Khan, R-pindi = Rawalpindi, S-godha = Sargodha.
Note: n= number of schemes have dug well facilities; n = 18.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

Table A8.11: Sanitary Hazards
(spring)

Information	(Yes response) Rawalpindi (n=11) No.	%
Area around the spring is unfenced.	11	**100**
Masonry protecting the spring source is faulty.	10	**91**
Spring lacks a surface water diversion ditch above it.	10	**91**
Spring source is unprotected and open to surface contamination.	9	**82**
There is a spring box and there is an unsanitary inspection cover in the masonry.	9	**82**
The spring box contains contaminating silt or dead animals.	7	**64**
Animals have access to within 10 meters of the spring source.	6	**55**
Latrines or other source of contamination uphill of the spring present.	6	**55**
There is an overflow pipe and it is unsanitary.	5	**45**
Air vent in the masonry is unsanitary.	2	**18**

No. = number.
Note: n = number of schemes have spring facilities in Rawalpindi district.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

Table A8.12: Sanitary Hazards
(tubewell with electric pump)

	B-Pur (n = 18)		C-wal (n = 3)		DG Khan (n = 16)		F-abad (n = 6)		RY Khan (n = 20)		R-pindi (n = 1)		S-godha (n = 8)		Total (n = 72)	
Information	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Water is supplied without disinfection	18	82	2	67	15	94	5	83	20	100	1	100	8	100	69	96
Chlorine is absent at the sampling tap at source	15	68	3	100	15	94	4	67	19	95	1	100	8	100	65	90
Any other source of pollution (e.g., animal excreta, rubbish, water) within 10 m of well.	17	77	3	100	11	69	5	83	17	85	1	100	6	75	60	83
Well seal is unsanitary	12	55	1	33	9	56	3	50	17	85	0	0	4	50	46	64
Floor of the pump house cracked/ permeable to water.	10	45	1	33	2	13	2	33	17	85	0	0	3	38	35	49
No drainage area around the pump house	8	36	2	67	4	25	2	33	12	60	0	0	6	75	34	47
Uncapped well within 15 – 20 m of the borehole	0	0	2	67	0	0	2	33	1	5	0	0	3	38	8	11
Protection/fencing around the well damaged allowing	1	5	2	67	1	6	0	0	3	15	0	0	0	0	7	10

Information	B-Pur (n = 18)		C-wal (n = 3)		DG Khan (n = 16)		F-abad (n = 6)		RY Khan (n = 20)		R-pindi (n = 1)		S-godha (n = 8)		Total (n = 72)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
others/animals access																
Latrine or washroom within 15 m – 20 m of the pump house that percolates into the soil, i.e., no sewerage	1	5	2	67	1	6	1	17	0	0	0	0	0	0	5	7

B-pur = Bahawalpur, C-wal = Chakwal, F-abad = Faisalabad, DG Khan = Dera Ghazi Khan, m = meter, No. = number, RY Khan = Rahim Yar Khan, R-pindi = Rawalpindi, S-godha = Sargodha.
Note: n= number of schemes have dug well facilities; n = 18.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

27. Springs are used as sources of drinking water mostly in Rawalpindi District. The most common sanitary risks associated with spring sources are (i) an unfenced area around the spring, (ii) faulty masonry protecting the spring, (iii) the lack of a ditch to divert surface water, and (iv) an unprotected spring open to surface contamination. As with dug wells, none of the sanitary hazards require costly mitigation measures, and with little investment these spring sources can be protected to ensure delivery of safe water at all times.

28. Key sanitary risks associated with tubewells with electric pumps identified in the sanitary inspection report were (i) water being supplied without disinfection with chlorine at the sampling tap source; (ii) other sources of pollution (e.g., animal excreta and wastewater) within 10 meters of the well; and (iii) unsanitary seals on the wells. Interestingly, chlorinators were installed at most tubewells, but the lack of regular supplies of disinfectants contributed to irregular practice. As with sources, simple mitigation measures could ensure the delivery of safe water at all times.

8. Operation and Maintenance

29. The study looked at five key facets of the operation and maintenance (O&M) of the subprojects: (i) problem-reporting mechanisms, (ii) user-payment systems, (iii) the organization of repairs, and (iv) income and expenditure associated with O&M. A good problem-reporting mechanism is important to ensure customer satisfaction and positive willingness to pay for the services received. Otherwise, customer dissatisfaction eventually leads to loss of community trust in the body managing the subproject, poor cost recovery, and the failure of the system. A well-established system of user-payment is essential for the long-term sustainability of a community-managed rural water supply scheme. The problem-reporting mechanism and user-payment system are linked. Further, an effective method of organizing repairs ensures the timely availability of spare parts and substantially reduces downtime to a manageable level. Finally, income and expenditure streams need to be aligned in the short run to meet operational expenditure and in the long run for cost recovery. Subproject beneficiaries need to be aware to protect the system through community action.

30. Sixty-two percent of the sample subprojects and 77% of functional sample subprojects meet the benchmark for a problem-reporting mechanism.[10] However, 91% of the nonfunctional subprojects did not have a caretaker, so there was no effective mechanism of reporting

[10] A caretaker is available and users are aware of the system for reporting through the caretaker but are not always informed about progress in handling complaints.

problems. As proportionately more subprojects under the PRWSSP are nonfunctional, it is not surprising that PCWSSP subprojects had a more satisfactory mechanism of reporting problems and a better system to redress complaints from beneficiaries. By district, Rahim Yar Khan subprojects were the best performers, as 81% had a system of problem reporting at the benchmark or higher level (Table A8.13).[11]

Table A8.13: Subprojects Reporting a System of Reporting Problems

District	Bad: Caretaker not available, water point stays under repair for long periods of time		Caretaker available, but users do not know about system for reporting (through caretaker)		Benchmark: Caretaker available, users aware reporting system, but are not always informed about progress on handling of complaints		In addition, caretaker keeps users informed about progress on the handling of their complaint- but does not always follow up to get the fault repaired		Ideal: In addition, caretaker follow up and gets faults repaired within a reasonable period of time		Total number of schemes in the district	Cumulative responses for benchmark and above (%)
	No.	%	No.	%	No.	%	No.	%	No.	%		
Bahawalpur	4	18	3	14	4	18	6	27	5	23	22	68
Chakwal	10	48	1	5	4	19	2	10	4	19	21	48
DG Khan	5	28	3	17	6	33	2	11	2	11	18	56
Faisalabad	1	14	2	29	0	0	2	29	2	29	7	57
RY Khan	2	10	2	10	9	43	3	14	5	24	21	81
Rawalpindi	6	35	2	12	5	29	2	12	2	12	17	53
Sargodha	2	22	1	11	3	33	2	22	1	11	9	67
Total	30	26	14	12	31	27	19	17	21	18	115	62

DG Khan = Dera Ghazi Khan, No. = number, RY Khan = Rahim Yar Khan.
Source: Independent Evaluation Department. 2008. Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan). Manila.

31. Less than half of the subprojects (47%) had a benchmark or better system of user payment for services, and 39% had no system at all. Nearly twice as many PRWSSP than PCWSSP subprojects had no user payment system. Proportionately, more PCWSSP subprojects met the benchmark than did PRWSSP subprojects. Faisalabad outperformed other districts in having at least a benchmark system of user payment, evidenced in 71% of subprojects. Dera Ghazi Khan and Rawalpindi were the poorest performers (Table A8.14). Nine of 10 nonfunctional subprojects lacked any system.

[11] The study recognizes that the regular presence of a caretaker may not be necessary for gravity-based subprojects, so the low values for Chakwal and Rawalpindi in Table A8.13 should be interpreted with caution.

Table A8.14: System of user payment for Operation and Maintenance of Subprojects
(by district)

District	Bad: No system of regular user payment - and no payment		There is a system of regular user payment, but no payments or payments are irregular		Benchmark: There is a system of regular payment and most pay regularly; OR they collect payment as and when needed for major repair and rehab		There is a system of payments and all pay regularly - even to cover major repair and rehab		Ideal: In addition, payment is based on ability to pay (graded rate system)		Total number of schemes in the district	Cumulative responses for benchmark and above (%)
	No.	%	No.	%	No.	%	No.	%	No.	%		
Bahawalpur	8	36	2	9	5	23	6	27	1	5	22	55
Chakwal	10	48	1	5	7	33	3	14	0	0	21	48
DG Khan	6	33	6	33	6	33	0	0	0	0	18	33.3
Faisalabad	1	14	1	14	2	29	3	43	0	0	7	71.4
RY Khan	7	33	3	14	2	10	9	43	0	0	21	52.4
Rawalpindi	10	59	1	6	5	29	1	6	0	0	17	35.3
Sargodha	3	33	2	22	3	33	1	11	0	0	9	44.4
Total	45	39	16	14	30	26	23	20	1	1	115	47

DG Khan = Dera Ghazi Khan, No. = number, RY Khan = Rahim Yar Khan.
Source: Independent Evaluation Department. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

32. The organization of repair work to subprojects varied widely. In a vast majority of functional subprojects, 70% of minor repair works and 59% of major repair works were organized by community organizations (Figures A8.13 and A8.14). The minor repairs of one in five functional subprojects were handled by a group of local elites or dominant users, and one in six by users themselves. Slightly more than one fifth of the subprojects had major repairs handled by the users themselves. In a handful of cases, the Public Health Engineering Department (PHED) took responsibility for major repairs. On the other hand, all repair work in nonfunctional subprojects (if any was done) was undertaken by individual users in an informal manner. Similarly, in 60% of the non-project water supply schemes, both minor and major repair works were done by users themselves, with local community-based organizations or elite members of society taking responsibility for remaining 40% of the schemes.

33. Nearly three fifths of functional subprojects (58%) did not have any major repairs up until the interview. For those reporting major repairs, system downtime ranged from less than 3 days to more than 4 weeks, but in two thirds of the functional subprojects downtime was less than 3 days. However, all four nonfunctional subprojects had downtime of more than 4 weeks. Similarly, four of the 14 non-project water supply schemes reported major repair, which took 4 weeks in one case, 1–2 weeks in two cases, and less than 3 days in the last case.

34. While almost the same proportion of subprojects under the two projects reported downtime for major repairs (29% for the PRWSSP and 32% for the PCWSSP), no marked difference was observed between the two projects (Table A8.15). More than half of the major subproject faults were fixed in less than 3 days. Since water supply hours are intermittent, it may be that the operators could manage to attend to repairs without interrupting supply, thus

ensuring a higher "no breakdown, continuous supply" response of 55%. Roughly the same proportion of subprojects under both the PRWSSP and the PCWSSP reported downtime for minor repairs. Half of the minor faults were fixed within 24 hours, and three fourths within 2 calendar days.

Table A8.15: Availability of Spare Parts at the Subprojects

District	Bad: No spare parts available		Initial stock of spare parts exhausted, not replaced		Benchmark: Standard spare part stock available (parts used were replaced)		In addition, more spare parts than standard now made available by CBO		Ideal: In addition, CBO has arranged locally for replacement of all spare parts		Total number of schemes in the district	Cumulative responses for benchmark and above (%)
	No.	%	No.	%	No.	%	No.	%	No.	%		
Bahawalpur	11	50	7	32	4	18	0	0	0	0	22	18
Chakwal	13	62	4	19	3	14	0	0	1	5	21	19.0
DG Khan	10	56	3	17	5	28	0	0	0	0	18	27.8
Faisalabad	2	29	4	57	1	14	0	0	0	0	7	14.3
RY Khan	12	57	5	24	4	19	0	0	0	0	21	19.0
Rawalpindi	13	76	4	24	0	0	0	0	0	0	17	0.0
Sargodha	6	67	2	22	1	11	0	0	0	0	9	11.1
Total	67	58	29	25	18	16	0	0	1	1	115	17

CBO = community-based organization, DG Khan = Dera Ghazi Khan, No. = number, RY Khan = Rahim Yar Khan.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

35. Spare part supply was identified as the weakest link in O&M across all districts. An overwhelming majority of the 115 sample subprojects (83%) had either no provision or had exhausted their initial stock of spare parts (Table A8.16). Dera Ghazi Khan had the highest number of subprojects with spare parts (28%), while none of the subprojects in Rawalpindi had any. Only one in six subprojects reported meeting the benchmark for having spare parts.[12]

Table A8.16: Spare Parts Availability in Subprojects

	Revenue Collected					Type of Water Rates						
	Yes		No		Total No.	Flat Rate		Based on Plot Size		Metering		Total No.
Item	No.	%	No.	%		No.	%	No.	%	No.	%	
Project												
PRWSSP	32	64	18	36	50	30	94	1	3	1	3	32
PCWSSP	58	89	7	11	65	55	95	0	0	3	5	58
Category												
WS	44	90	5	10	49	44	94	0	0	3	6	47
WSS	46	70	20	30	66	41	95	1	2	1	2	43

[12] Standard spare parts are available in stock, with parts that are used being replaced.

Type of Scheme												
New	69	75	23	25	92	65	94	1	1	3	4	69
Rehabilitated	21	91	2	9	23	20	95	0	0	1	5	21
Scheme Status												
Functional	88	96	4	4	92	83	94	1	1	4	5	88
Nonfunctional	2	9	21	91	23	2	100	0	0	0	0	2
Total	90	78	25	22	115	85	94	1	1	4	4	90

No. = number, PCWSSP = Punjab Community Water Supply and Sanitation Project, PRWSSP = Punjab Rural Water Supply and Sanitation Project, WS = water supply, WSS = water supply and sanitation.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

9. Financial Sustainability

36. The financial sustainability of rural WSS subprojects demands that the revenue collected meets recurring O&M costs in the short run and subproject costs in the long run. If the revenue collected does not meet recurring costs, the infrastructure is likely to fall into disrepair and eventually close down for not paying bills, particularly for electricity,[13] spare parts, and caretakers' wages. Balanced cash flow requires that the incoming revenue stream matches outgoing expenditure.

37. Field data show that 78% of the sample subprojects collected revenues for system O&M (64% in the PRWSSP versus 89% in the PCWSSP) (Table A8.25). In both projects, 94–95% of community organizations reported having a flat rate system, with household metering practiced in only 5% of the subprojects, all under the PCWSSP. Only one community organization had adopted revenue collection based on plot size. This was associated with multiple uses of water for household and kitchen garden requirements. Interestingly, water supply subprojects were reported to have a higher percentage of revenue collection than WSS subprojects (90% versus 70%). It was confirmed that rehabilitation subprojects had higher revenue collection than did new construction subprojects (91% versus 75%), which is associated with relatively lower monthly water charges for gravity-based subprojects than for pumped tubewells.

38. Revenue collection in southern district subprojects was higher (Rahim Yar Khan 90%, Dera Ghazi Khan 89%, and Bahawalpur 86%) than in northern districts (Sargodha 78%, Faisalabad 71%, Rawalpindi 65%, and Chakwal 62%) (Table A8.17).[14] Water metering, which is the fairest system of revenue collection, was found in Chakwal and Rawalpindi districts. This indicates that the current practice of flat rate revenue collection may not be to the liking of communities in these two districts. More communities may, in fact, opt for water metering in the future with limited external assistance.

[13] For tubewells with electric pumps.
[14] Chakwal and Rawalpindi also had higher percentages of nonfunctional subprojects.

Table A8.17: Revenue from Water Supply Scheme Collected

	Revenue Collected					Type of Water Rates							
	Yes		No		Total No.	Flat Rate		Based on Plot Size		Metering		Total No.
Item	No.	%	No.	%		No.	%	No.	%	No.	%	
Bahawalpur	19	86	3	14	22	18	95	1	5	0	0	19
DG Khan	16	89	2	11	18	16	100	0	0	0	0	16
RY Khan	19	90	2	10	21	19	100	0	0	0	0	19
Chakwal	13	62	8	38	21	10	77	0	0	3	23	13
Faisalabad	5	71	2	29	7	5	100	0	0	0	0	5
Rawalpindi	11	65	6	35	17	10	91	0	0	1	9	11
Sargodha	7	78	2	22	9	7	100	0	0	0	0	7
Total	90	78	25	22	115	85	94	1	1	4	4	90

DG Khan = Dera Ghazi Khan, No. = number, RY Khan = Rahim Yar Khan.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

39. No systematic data collection exists on revenues and expenditures by subproject, so income and expenditure could not be accurately established. However, the study collected revenue and expenditure data for 115 sample subprojects for the 3 months of May, June, and July 2008.[15] Cumulative total revenue for the 3 months was higher than expenditure in Chakwal, Faisalabad, Rahim Yar Khan, and Sargodha but fell short in Rawalpindi, Dera Ghazi Khan, and Bahawalpur.[16]

10. Technical Self Evaluation by Community Organizations

40. Community organizations were asked to assess the physical condition of subprojects at the time of evaluation compared with their status at the time of handover. The responses were recorded as (i) worse, (ii) the same, and (iii) better. Fifty-two percent of the subprojects were reported to have deteriorated, while only 5% were considered better than before. Proportionately more PRWSSP subprojects were considered deteriorated than PCWSSP subprojects. According to respondents, their response reflected a dynamic situation in the physical conditions of the subprojects, and, if the trend were to continue, more subprojects would become nonfunctional unless mitigation measures are taken.

41. Nearly 83% of the nonfunctional subprojects faced lots of system problems and/or illegal service connections that harmed the original design capacity and water pressure. Only 9% of the functional subprojects faced similar problems. As a result, only 9% of subprojects met the benchmark of having no major system problems, illegal service connections, or additional investment over time, while 61% of functional subprojects met that benchmark. Only 30% of PRWSSP subprojects met the benchmark or higher standard, compared with 64% of PCWSSP subprojects. About 40% of the PRWSSP subprojects faced lots of system problems and/or illegal connections, compared with only 11% of PCWSSP subprojects.

[15] These are peak months for power consumption, but erratic power supply meant the full potential of subprojects could not be exploited.
[16] The power-generating Water and Power Development Authority increased electricity tariffs in 2008, and many community organizations have not been able to fully adjust to the higher power charges by revising billing norms.

42. Except for the village of Wairo in Chakwal District, none of sample or control village water supply systems had any water source protection plans developed and implemented. There was a marked difference in the level of awareness vis-à-vis source protection between communities with functional and nonfunctional schemes, as 70% of the communities with nonfunctional systems had little or no awareness of the need to protect sources. By contrast, communities with functional schemes were more aware of that need. In far fewer cases had communities taken any further action. No marked difference was noted between PRWSSP and PCWSSP communities.

43. To better understand if there were any efforts made to sensitize the community vis-à-vis water quality surveillance, the study asked beneficiaries if they were aware of the quality of their water supply. Out of the 115 sample subprojects, 70 communities (60%) knew that their subproject water quality was tested at the time of construction. Far fewer (less than 10%) could tell what the laboratory report contained in terms of the acceptability of their water. Awareness in subproject communities was significantly higher than in non-project communities, where only 7% knew about the quality of their drinking water.

B. An Assessment of Rural Water Supply and Sanitation Community-Based Organizations

44. The critical role of community-based organizations (CBOs) in the success of rural WSS subprojects was appropriately recognized in both sector projects. Both organized water users' groups in local communities and villages that would commit to participate in project activities. The communities received assistance from community development workers with social mobilization, the formation of CBOs, and building CBO capacity to run the subprojects. Drawing on lessons from the PRWSSP, project design for the PCWSSP paid particular attention to further strengthening the capacity of CBOs. Each CBO was expected to have an executive committee representing the community membership. Recognizing the importance of CBOs in the successful operation of the subprojects, the study conducted an in-depth analysis of them, with the findings summarized here.

1. Decision-Making Process in the Subproject Design

45. Key to the sustainability of rural WSS subprojects is the degree to which community voice and preferences are incorporated into planning and design to ensure a sense of system ownership. Study findings reveal that community involvement in planning and design strongly correlated with subprojects’ functional status, as 35% of nonfunctional subprojects had no community involvement in planning and design and another 35% had only limited involvement. In contrast, 74% of the communities considered their involvement adequate. No marked variation was found between PRWSSP and PCWSSP CBOs. However, CBO involvement varied considerably across the seven study districts. Rahim Yar Khan and Bahawalpur reported the highest involvement, at 95% and 86% respectively; compared with 61% reported for Chakwal and Dera Gazi Khan.

2. Gender Role

46. While women and girls are primarily responsible for fetching water for household needs, their participation in WSS planning, design, and O&M has been very limited. None the 115 subproject CBOs had women involved in their management committees for planning, design, or O&M. In almost all cases, direct interaction and communication with men were not permitted. The result was consistent across all seven study districts.

3. Dispute Resolution

47. Among many factors, social cohesion and mechanisms to resolve internal disputes critically contribute to the sustainability of community-managed schemes. Half of the communities had no disputes associated with WSS. Functional subprojects tended to have fewer disputes than did nonfunctional ones (30% versus 48%), as presented in Table A8.18. PRWSSP subprojects encountered more disputes than did PCWSSP ones (52% versus 38%). Even 18 months after project completion, one in six functional subprojects faced several unresolved disputes, which tended to be about land, nonpayment of water bills, authoritarian management style, docile CBOs, and political interference. While proportionately more rehabilitation subprojects encountered WSS-related disputes than did new construction subprojects, most of them were resolved amicably.

Table A8.18: Disputes Related to Water Supply and Sanitation
(percentage communities reporting)

	Scheme status				Type of Schemes				Project					
	Functional		Non-Functional		New		Rehabilitated		PRWSSP		PCWSSP		Total	
Disputes	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
None	48	52	16	70	50	54	14	61	24	48	40	62	64	56
Some but resolved	12	13	2	9	12	13	2	9	7	14	7	11	14	12
Frequent and resolved	6	7	0	0	6	7	0	0	1	2	5	8	6	5
Some but unresolved	10	11	2	9	7	8	5	22	4	8	8	12	12	10
Many and unresolved	16	17	3	13	17	18	2	9	14	28	5	8	19	17
Total	**92**	**100**	**23**	**100**	**92**	**100**	**23**	**100**	**50**	**100**	**65**	**100**	**115**	**100**

No. = number, PCWSSP = Punjab Community Water Supply and Sanitation Project, PRWSSP = Punjab Rural Water Supply and Sanitation Project.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

48. By district, Faisalabad boasted the highest percentage of communities reporting no disputes (71%), with Chakwal and Sargodha following close behind at 67 % each (Table A8.19). The communities reporting the highest percentage of unresolved disputes were Dera Ghazi Khan (39%), Bahawalpur (32%), and Rahim Yar Khan (29%), clearly establishing that the southern districts had more issues than their northern counterparts. Faisalabad presents a best-case scenario, with none of the communities having unresolved disputes.

Table A8.19: District Wise Disputes Related to Water Supply and Sanitation

	Districts															
	Bahawalpur		Chakwal		Dera Ghazi Khan		Faisalabad		Rahim Yar khan		Rawalpindi		Sargodha		Total	
Disputes	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
None	10	45	14	67	8	44	5	71	11	52	10	59	6	67	64	56
Some but resolved	3	14	1	5	2	11	2	29	1	5	3	18	2	22	14	12
Frequent and resolved	2	9	0	0	1	6	0	0	3	14	0	0	0	0	6	5

Some but unresolved	2	9	2	10	5	28	0	0	2	10	1	6	0	0	12	10
Many and unresolved	5	23	4	19	2	11	0	0	4	19	3	18	1	11	19	17
Cumulative % for 'Some' and 'frequent' but unresolved.		*32*		*29*		*39*		*0*		*29*		*24*		*11*		*27*
Total	22	100	21	100	18	100	7	100	21	100	17	100	9	100	115	100

No. = number.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

C. The Status of CBOs

49. CBOs formed for the O&M of WSS systems were classified into four categories based on their functional status:[17] (i) nonexistent, (ii) existent but nonfunctional, (iii) partly functional, and (iv) fully functional (Table A8.20). The functionality criteria included basic CBO activities, particularly O&M. Twenty-six percent of the sample subprojects reported having no CBOs, while 32% had CBOs that were deemed nonfunctional or defunct. In all, 49 CBOs were classified as either partly of fully functional. A higher proportion of PCWSSP CBOs were classified as more functional than PRWSSP ones (54% versus 28%). Seventy-nine percent of WSS systems in comparable communities without subprojects had no CBOs.

Table A8.20: Functional Status of WS/WSS CBOs

	PRWSSP		PCWSSP		Total	
CBO Status	**No.**	**%**	**No.**	**%**	**No.**	**%**
Nonexistent	14	28.0	12	18.5	26	22.6
Nonfunctional	22	44.0	18	27.7	40	34.8
Partially functional	8	16.0	21	32.3	29	25.2
Fully functional	6	12.0	14	21.5	20	17.4
Total	**50**	**100.0**	**65**	**100.0**	**115**	**100.0**

CBO = community-based organization, No. number, WS = water supply, WSS = water supply and sanitation.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan).* Manila.

50. Table A8.21 indicates that nearly two thirds of the functional CBOs had no change in membership, indicating stability in the organization or the dominance of existing members. One in 10 CBOs had entirely new members. There was no marked difference between PRWSSP and PCWSSP in the turnover of membership in functional CBOs.

Table A8.21: Membership Changes in the Functional WS/WSS CBOs

	PRWSSP		PCWSSP		Total	
CBO Status	**No.**	**%**	**No.**	**%**	**No.**	**%**
No Change	8	57.1	23	65.7	31	63.3
Broadly Same	3	21.4	6	17.1	9	18.4

[17] A CBO was considered functional if it carried out water distribution and O&M of the WSS system, collected water tariffs, and attempted to resolve disputes associated with water distribution.

Many New Members	2	14.3	2	5.7	4	8.2
Entirely New	1	7.1	4	11.4	5	10.2
Total	**14**	**100.0**	**35**	**100.0**	**49**	**100.0**

CBO = community-based organization, No. number, WS = water supply, WSS = water supply and sanitation.

Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

D. Maturity of CBOs Managing WSS Subprojects

51. The study adopted eight groups of parameters, each on a 5-point scale, to assess the maturity of each of the 49 functional sample CBOs. These were (i) leadership skills, (ii) management skills, (iii) finance and accounting skills, (iv) by-laws, (v) capability of workers engaged by CBOs, (vi) interaction with wider community, (vii) linkages and networking with other service providers, and (viii) record keeping and documentation skills. In all, 32 indicators were applied for the assessment. Each indicator had five options, and respondents were asked to identify one option they could associate with their CBO. The results are summarized in Table A8.22. Each group of indicators is summarized as weak, developing, or mature based on a score of less than 50%, 50–79%, and 80% and above. The maturity index of a CBO is based on score attainment. CBOs were characterized as beginners, low maturity, moderate maturity, and high maturity based on the scores of less than 25%, 25–49%, 50–79%, and 80% and above.

Table A8.22: Capacity Assessment of Functional CBOs in WSS Project Typology

	PRWSSP	PCWSSP	New	Rehab	WS	WSS	Total
	%	%	%	%	%	%	%
Leadership							
Weak	20.0	11.4	17.5	0.0	14.3	13.6	14.0
Developing	60.0	74.3	65.0	90.0	78.6	59.1	70.0
Mature	20.0	14.3	17.5	10.0	7.1	27.3	16.0
Management							
Weak	60.0	65.7	65.0	60.0	71.4	54.5	64.0
Developing	33.3	34.3	32.5	40.0	28.6	40.9	34.0
Mature	6.7	0.0	2.5	0.0	0.0	4.6	2.0
Finance and Accounting							
Weak	66.7	62.9	67.5	50.0	67.9	59.1	64.0
Developing	26.7	37.1	30.0	50.0	32.1	36.4	34.0
Mature	6.7	0.0	2.5	0.0	0.0	4.5	2.0
By-Laws							
Weak	80.0	94.3	87.5	100.0	100	77.3	90.0
Developing	13.3	2.9	7.5	0.0	0.0	13.6	6.0
Mature	6.7	2.9	5.0	0.0	0.0	9.1	4.0
Community Interaction							
Weak	53.3	37.1	42.5	40.0	35.7	50.0	42.0
Developing	20.0	48.6	40.0	40.0	46.4	31.8	40.0
Mature	26.7	14.3	17.5	20.0	17.9	18.2	10.0
Capacity of the Employees							
Weak	66.7	57.1	65.0	40.0	60.7	59.1	60.0
Developing	33.3	42.9	35.0	60.0	39.3	40.9	40.0
Mature	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Linkages and Networking							

Weak	93.7	91.4	97.5	70.0	92.9	90.9	92.0
Developing	0.0	8.6	0.0	30.0	7.1	4.5	6.0
Mature	6.7	0.0	2.5	0.0	4.5	4.5	2.0
Record Keeping/ Documentation							
Weak	66.7	97.1	87.5	90.0	92.9	81.8	88
Developing	33.3	0.0	12.5	0.0	3.6	18.2	10
Mature	0.0	2.9	0.0	10.0	3.6	0.0	2.0

Rehab = rehabilitated, WS = water supply, WSS = water supply and sanitation.
Source: Independent Evaluation Department. 2008. *Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan)*. Manila.

52. The assessment shows weak CBO performance in six of the eight categories, moderate in one, and between weak and moderate in the last category. In particular, linkages and networking, by-laws, and record keeping and documentation appear to be the weakest of all attributes. It may be that the CBOs were formed at the initiation of the WSS system but lacked adequate support after subproject completion. The performance of functional CBOs is summarized in Table A8.23. A little over three fifths of functional CBOs have low maturity, while 38% have moderate-to-high maturity. No marked differences were noted between the PRWSSP and the PCWSSP, new construction and rehabilitation, or water supply and WSS types.

Table A8.23: Capacity Assessment of Functional CBOs in WSS Classification of CBOs Based on Maturity Index

Maturity Level	PRWSSP	PCWSSP	New	Rehab	WS	WSS	Total
	%	%	%	%	%	%	%
Beginners (a)	0.0	2.9	2.5	0.0	3.6	0.0	2.0
Low (b)	60.0	60.0	60.0	60.0	60.7	59.9	60.0
Moderate (c)	33.3	37.1	35.0	40.0	35.7	36.4	36.0
High (d)	6.7	0.0	2.5	0.0	0.0	4.6	2.0

Rehab = rehabilitated, WS = water supply, WSS = water supply and sanitation.
Note: a= overall score less than 25% of the total, b = 25%–50% score, c = 50%–80%, and d = 80% and above.
Source: Independent Evaluation Department. 2008. Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan). Manila.

E. Project Assistance

53. Functional CBOs received assistance from the projects in one or more forms. More than four fifths of the CBOs obtained at least one form of training. Training covered (i) CBO operation, (ii) O&M of WSS systems, (iii), book-keeping, (iv) hygiene education and sanitation awareness, and (v) income generation (Table A8.24). Training benefits accrued to CBO executive members, with the exception of O&M, which was imparted to pump operators. There was no significant difference between PRWSSP and PCWSSP subprojects. The training program did not develop training of trainers, so no significant multiplier effect was noted. According to respondents, no follow-up training was imparted to CBO members.

Table A8.24: Assistance Obtained by Functional CBOs from the Project Activities
(percent of CBOs reporting, n = 49)

Type of Assistance Received	PRWSSP	PCWSSP	Total
Training	78.6	82.9	81.6
Construction of New Water Supply System	100.0	67.7	81.7
Rehabilitation of Water Supply System	0.0	32.3	18.3
Construction of New Drainage System	86.0	29.2	53.9
Rehabilitation of Drainage System	0.0	6.2	3.5
Hygiene Education and Sanitation Awareness	22.0	32.3	27.8
Linkages to Service Providers	2.0	6.2	4.4
Microfinance funds	6.0	10.8	8.7

Rehab = rehabilitated, WS = water supply, WSS = water supply and sanitation.
Source: Independent Evaluation Department. 2008. Rigorous Impact Evaluation Survey of Water Supply and Sanitation in Punjab (Pakistan). Manila (data for Table A8.22).

54. The projects had a major focus on the construction of new water supply systems in both phases. The PCWSSP also accommodated some system rehabilitation. Slightly more than half of the subprojects had a drainage component as well, but proportionately much more under the PRWSSP. The rehabilitation of drainage systems was less of a priority. Less than one in three CBOs received hygiene and sanitation awareness support, but proportionately more in the case of the PCWSSP than the PRWSSP.

55. The sector projects were designed as integrated water supply, sanitation, and hygiene-promotion interventions. Dedicated community development and hygiene promotion staff were hired. Information, education, and communication materials were developed in collaboration with key sector agencies such as the United Nations Children Fund Lahore. Hygiene education sessions were conducted and trainings were reported to have been held to train CBO members. The effectiveness of the hygiene promotion activities and trainings were judged during the focus group discussions based on community recall of such events and the presence and recall of training materials such as posters, promotional compact discs, banners, and stickers, etc. Demo latrines were constructed and masons trained, with the idea that others in the village would subsequently construct their own latrines. Survey data found that only 2% of communities recalled having received the health and hygiene-related trainings. In all, 38% of communities did not remember receiving or seeing any training materials, with more than half of PRWSSP communities (52%) not known to have received any such materials, compared with 28% of PCWSSP communities.

56. Very few CBOs received support in linking with other service providers and microfinance institutions, despite the claim that these were highly successful initiatives, as reported in the project completion report for the PCWSSP. As the major nongovernmental organizations were already present in the communities, the degree of facilitation by the project for the community members with them could not be ascertained with certainty.

MANAGEMENT RESPONSE TO THE IMPACT OF RURAL WATER SUPPLY AND SANITATION IN PUNJAB, PAKISTAN

On 21 September 2009, the Director General, Independent Evaluation Department, received the following response from the Managing Director General on behalf of Management:

I. General Comments

1. We appreciate IED's Impact Evaluation Study of Rural Water Supply and Sanitation (WSS) in Punjab, Pakistan, and agree with all the recommendations for improving the impact of rural WSS projects in the region.

II. Specific Comments

2. **Recommendation 1. Gender benefits should receive more prominence in similar ADB projects.** We agree. From January 2010, gender will be mainstreamed in the program/project design, with increased focus on women's role as informed and empowered water consumers. All WSS projects will incorporate gender action plans. WSS projects in Pakistan and the Kyrgyz Republic processed in 2008 and 2009, respectively, already have gender action plans. The board of the first regional utility established under the Sindh Cities Improvement Investment Program in 2008 will have two highly qualified women independent directors, one third of the total.

3. **Recommendation 2. ADB WSS projects designs should address waste management concurrently.** We agree. Starting 2009, all WSS projects will be reviewed and assessed to incorporate waste management concurrently in project design. Several programs/projects have already incorporated waste management in their services provision, including the Sindh Cities Improvement Investment Program. This practice will continue.

4. **Recommendation 3. ADB should actively strengthen existing collaborations and partnerships and foster new ones with other development partners and developing member countries.** We agree. The Country Partnership Strategy and Country Partnership Strategy Update, as well as individual programs/projects processing and implementation, will focus on more inter-agency coordination.

5. **Recommendation 4. ADB should establish a user-friendly depository of all available baseline studies and associated databases.** We agree. From January 2010, WSS programs/projects will start establishing baseline data. Work has begun on establishing baseline data for result monitoring and evaluation using the ADB Results Framework indicators.

6. Recommendation 5. ADB should follow-up with the Government of Punjab to address the following: (i) functional link between Public Health Engineering Department and *tehsil* municipal administrations and the

private sector is strengthened; (ii) subprojects become financially viable with provisions for routine maintenance, operation and maintenance, and capital replacement; (iii) nonfunctional subprojects are revived if technically and economically feasible; and (iv) nonfunctional or partly functional community-based organizations become fully functional through capacity building by engaged competent nongovernment organizations and private sector entities. We agree. Pakistan needs more robust and sustainable institutional mechanisms for rural and urban services delivery. The problem is not infrastructure and funding; it is management, incentives, and accountability.

7. ADB is committed to strengthen its partnership with the Government of Punjab through a new multitranche facility for cities improvement. ADB is now focusing on urban WSS and the (i) creation of regional utilities, based on principles of increasing professionalized and commercial operations; (ii) enhancing accountability and sustainability through contractual agreements; (iii) leveraging private sector expertise; (iv) harnessing economies of scale; and (iv) empowering consumers. As the focus is largely on urban WSS, it is not expected that further resources will be provided through project lending for reviving nonfunctional subprojects or community-based organizations. However, program lending to support rural revitalization, increased efficiency in government, and enhanced private sector partnerships will support an enabling environment for the above recommendations.

DEVELOPMENT EFFECTIVENESS COMMITTEE

Chair's Summary of the Committee Discussion on 23 September 2009

Impact of Rural Water Supply and Sanitation in Punjab, Pakistan

1. The Development Effectiveness Committee (DEC) highlighted the importance of combining water and sanitation components in water supply projects to maximize the health-related benefits. However, in this case, the impact on health was found "insignificant." The Independent Evaluation Department (IED) emphasized that the incidence of diarrhea was low to start with, so there was little room for improvement. Besides, the sanitation component was under-funded. Clearly the local communities also needed training in hygiene. They also appeared not to have been told that they did not need to boil the piped water since they continued doing it. Better extension work would improve the impact on health of these water and sanitation projects. The Management representative explained that health awareness was covered in these projects, but he noted the need to strengthen this area. He acknowledged the need to include more sanitation components in such water projects for increased health effectiveness.

2. DEC noted that sustainability was a key issue in these projects, and maintenance of the water supply systems was poor due to financial constraints and lack of training. DEC wondered as to what should be done with these non-functioning schemes. Management did not appear to be keen to follow up with the government of Punjab on sustainability issues. IED noted that the Asian Development Bank (ADB) is continuing its dialogue with the government on sustainability. Management representatives pointed out that ADB is working with the government of Punjab on secondary cities, bringing in management incentives and accountability measures to address some of the sustainability issues. They also emphasized the need for constant follow up to ensure sustainability; it would be a mistake to simply organize and train the community, and then leave it to them. If the system breaks down, the district government must provide the necessary support, and it must monitor the quality of the water. With respect to chlorination, the community is given the kit; but because they are poor, they want to cut costs by using fewer tablets, and thereby end up reducing the effectiveness of the treatment. Constant monitoring is needed if such projects are to be successful.

3. One DEC member noticed that the project did not include provisions to ensure that the poorest of the poor households would benefit, as some of the rural water supply and sanitation projects required up-front payments. This was seen as a serious flaw in the project design.

4. Referring to data in Appendix 1, DEC inquired why the more recent project preparatory technical assistance in Pakistan was more successful than the older one, even though the first one had involved a higher cost. IED explained that the second project followed on from the first one, and it had benefited from lessons learned from the first project. Management representatives added that policy was developed during the first project, as well as relevant procedures, which had contributed to the success of the second one.

Conclusions

5. DEC underscored the importance of health and water supply in ADB's operations.

6. DEC saw further scope to improve the health benefits from water supply schemes by including a larger component of extension work through training, education on hygiene, better utilization of chlorination plants, and integrating sanitation with water supply projects.

7. DEC reiterated the need for post-completion monitoring to ensure that ADB's projects are sustained even after the project is "officially" closed.

Ashok K. Lahiri
Chair
Development Effectiveness Committee